(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

AUGUST, 1907

100,000 LB. CAPACITY DYNAMOMETER CAR.

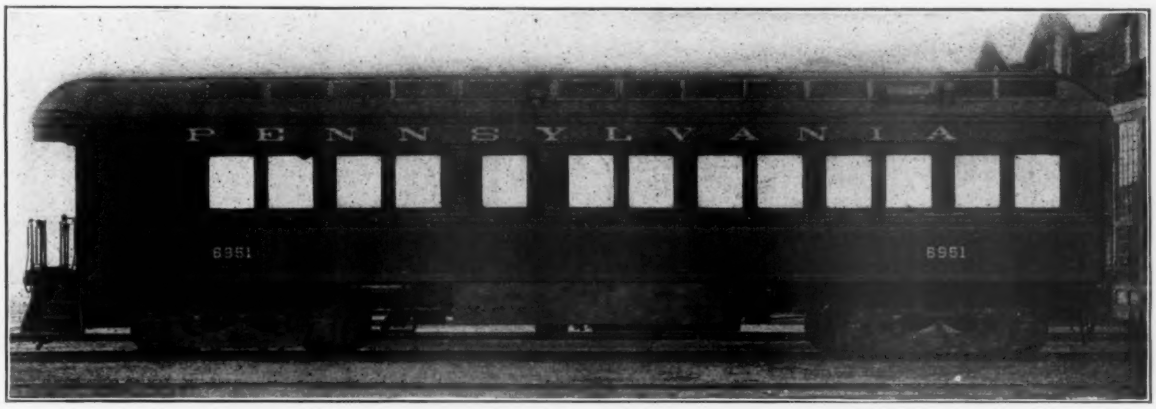
PENNSYLVANIA RAILROAD.

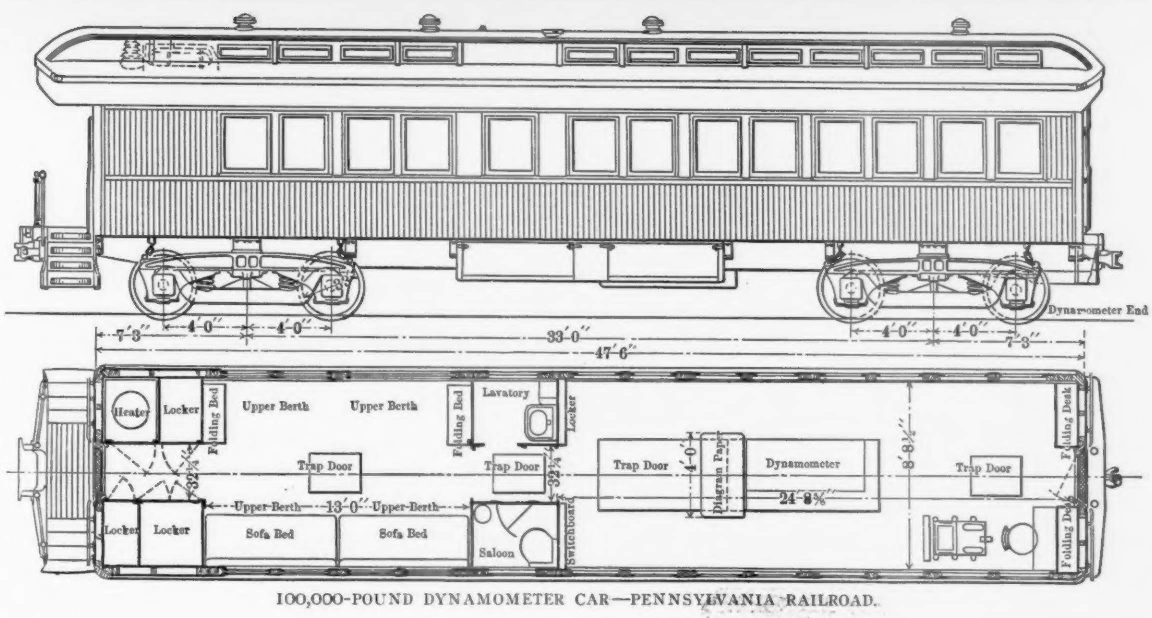
The Pennsylvania Railroad has recently completed a new dynamometer car which, in its construction and working, embodies the result of many years of tests and experiment, and is undoubtedly the best car of its type that has ever been built in this country.

This makes the fifth dynamometer car which the Pennsylvania Railroad has constructed, the earlier three of which were simple and crude affairs compared to the later cars. The fourth car, built in 1885, had a capacity of 28,000 lbs., and has been the means of obtaining a vast amount of very valuable information during its 22 years service. It, however, is altogether too light for modern trains, and the later car has been given a capacity of 100,000 lbs.

The dynamometer complete, with all its attachments, was designed, built and will be patented by Mr. A. H. Emery, of Stamford, Conn., who also constructed the dynamometer used in the former car. The car body complete, as well as the paper driving mechanism and other recording apparatus outside of the dynamometer, was designed and built at Altoona. The specifications for the dynamometer called for a maximum capacity of 100,000 lbs. and a maximum movement of the recording pen of 10 in., the motion to be in the same direction from the base line for either push or pull, and the apparatus to be adjustable so that the value of one inch of motion of the pen could be made to be either 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000 or 10,000 lbs.

After considering several different systems for the dynamometer it was finally decided to use the hydraulic principle in which all of the load on the drawbar should be transmitted directly to the piston of a large hydraulic cylinder secured to the frame of the car. The pressure exerted by this piston on the fluid in the cylinder to be carried to the piston of a small recording cylinder, the movement of which is restricted by a number of carefully calibrated helical springs. The strength of each set of springs will determine the amount of movement of the recording pen secured to the end of the piston rod of the small cylinder, for any pressure exerted on the large hydraulic cylinder or main press. Thus by knowing the relative areas of the two pistons and the amount that the springs will compress under a certain load, the load on the drawbar corresponding to the movement of the recording pen can easily be determined.





100,000-POUND DYNAMOMETER CAR—PENNSYLVANIA RAILROAD.

Taking up first the general construction of the car body. Reference to the illustrations will show its general exterior and interior appearance. It is built with a platform at one end, the opposite end, which carries the drawbar connected to the dynamometer, being built blind. The superstructure is much the same as an ordinary wooden passenger coach.

The underframe is made up entirely of steel. The side sills are formed of five inch 17.9 pounds "Z" bars attached to the center sills by means of cantilevers. The center sill is built up in the form of a box girder 38¾ in. wide inside, 20 in. deep, and extending the entire length of the car. This sill consists of two

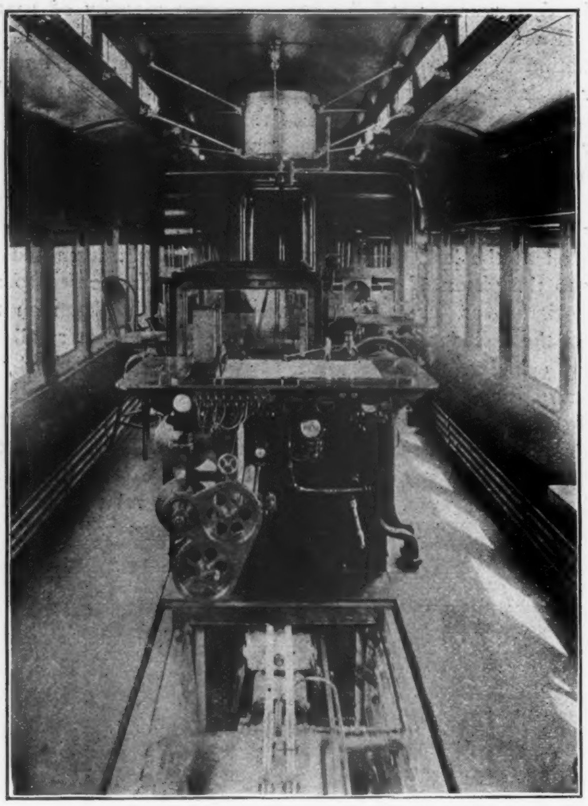


FIG. 3.—INTERIOR OF THE WORKROOM.

20 x ¾ in. plates with ½ in. cover plates top and bottom, the corners being reinforced by 3½ x 3½ x ⅝ in. angles. Within this girder is placed the housing of the main press, which is built up of 1⅜ in. plates securely riveted to the sides of the ¾ in. plates besides being reinforced by three steel castings. This section of the sill has to act as a foundation for all the delicate apparatus in the car, as well as to carry the heavy strains transferred to it by means of the piston rod which passes through the cylinder to the forward end of the car at which place it is attached to the draft gear by means of a heavy cast-steel housing, the details of which are shown in Fig. 8.

The trucks are of special and heavy construction, having an 8 ft. 0 in. wheel base and of a style somewhat like a locomotive truck. The journal boxes are fitted with equalizers, upon which rests double sets of elliptic and helical springs. The truck bolster is pressed steel connected at the ends by means of a transom to the cast steel side frames, to which are also bolted the pedestal jaws. The journal boxes are of a special design, being fitted up with oil trays, which not only carry the oil but support a special lubricating pad held up against the journal by means of two helical springs. The lid is never removed for ordinary oiling, as provisions have been made by an additional opening covered by a small lid, so as to insure a good seal. The axles are fitted with thirty-three inch steel tired wheels, having spoke centers, journals being 5½ x 10 in.

The forward wheels of the rear truck, figuring the dynamometer end as the front end of the car, are of special design, and are not equipped with brake rigging. These wheels drive the paper mechanism, and for that reason they have been very carefully and accurately turned with a straight tread. When it is considered that a slight change in the diameter of these wheels

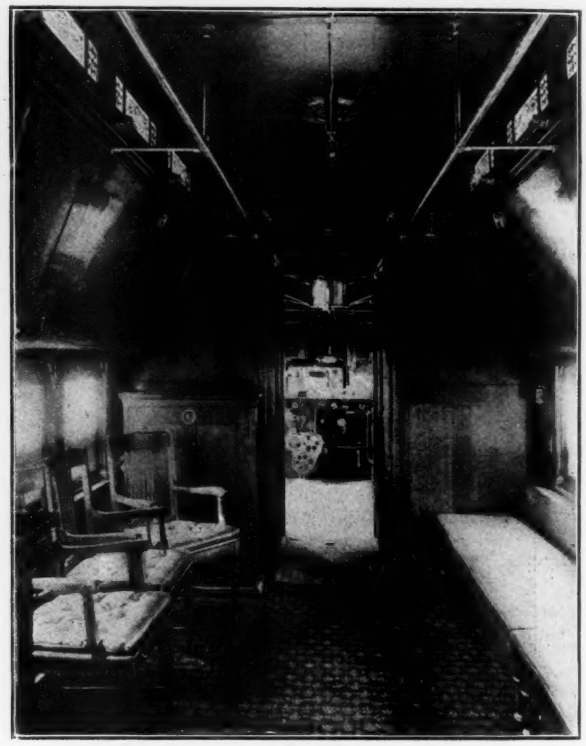


FIG. 4.—INTERIOR OF THE LIVING ROOM.

will make a very large difference in the number of revolutions they make in a 10-mile distance, and hence in the movement of the paper below the recording pen, it is easily understood why special care should be given at this point, and why the tread is made straight instead of coned.

The interior of the car is divided into two main compartments, the larger of which, at the forward end, is known as the workroom and the other, which is directly back of it, being separated by the lavatories, is known as the living room. Back of the latter is a short aisle on one side of which is a heater and a large closet for supplies, and on the other a compartment for coal, oil, etc., ahead of which is a space for a case in which the recording springs of the dynamometer are kept immersed in oil when not in use. The living room, which is 13 ft. 0 in. long, contains four upper berths, two sofa beds, and two cabinet beds, also several chairs and a table, which can be taken apart and stored underneath a berth. It is in this room that the results of the runs can be worked up or the room can be used as a dining-room, there being electric cooking utensils provided in the car. It also can, of course, be used as sleeping quarters, the accommodations being suitable for a crew of eight men. In the workroom, which is 24 ft. 8 in. long, is contained the weighing and recording apparatus, located in the center of the room; a direct con-

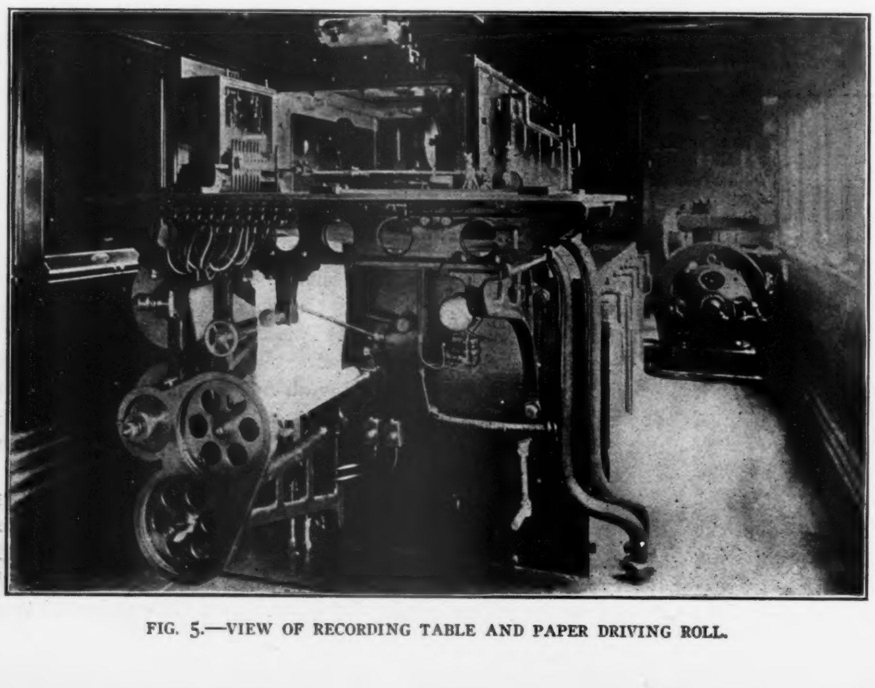


FIG. 5.—VIEW OF RECORDING TABLE AND PAPER DRIVING ROLL.

nected 2½ h.p. oil engine generator set; two folding desks, switchboard and tool cabinets, etc. The photographic illustrations will show the appearance of these different rooms.

The car is lighted by electricity, a storage battery of 32 cells located beneath the car being provided for this purpose. This battery can be charged from the direct connected set on the car when other means are not available. All of the small closets in the car are provided with electric lights, which are turned on by the opening of the doors. A number of plugs are also provided for portable lights. The Thrumveller heating system has been installed and provision is also made for connection to steam from the locomotive or from steam lines in the yard. No provision is made for a cupola or elevated lookout window, such as is usually provided in cars of this type, and the exterior observations are made through a glass shield which can be fitted to any of the side windows, and permits the observer to have a clear view ahead.

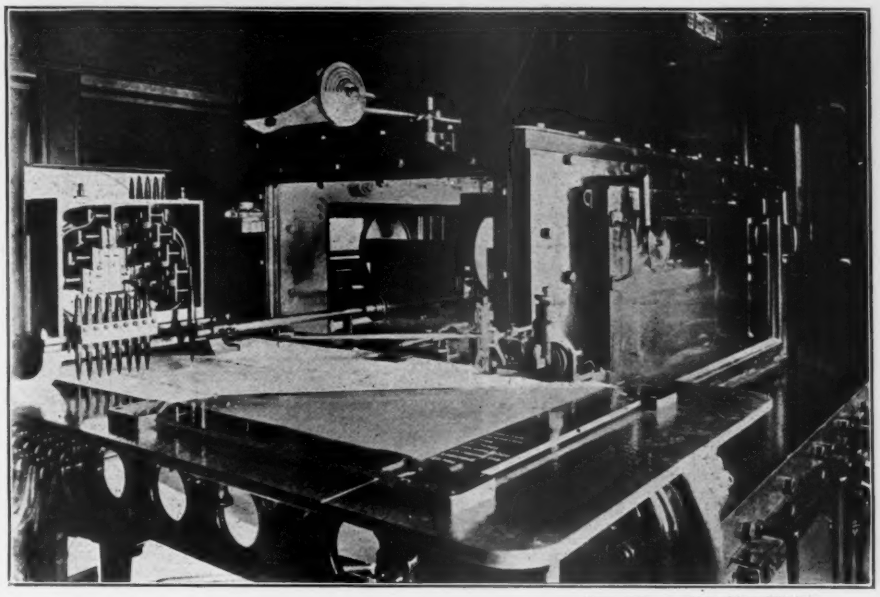


FIG. 7.—VIEW OF TABLE SHOWING RECORDING PENS.

The car measures 47 ft. 6 in. over end sills and weighs about 62 tons complete in working order. The interior finishing and furniture are specially noticeable for their richness and simplicity.

Paper Driving Mechanism.—The paper mechanism is driven, as mentioned above, from the forward axle of the rear truck. This axle was specially made and contains at its center a spiral gear which is integral with it. This gear meshes with a similar spiral gear keyed to a horizontal shaft, which runs forward a distance of about 21 ft., where it ends in a bevel gear. Here the motion is carried to a vertical shaft projecting up into the case beneath the case containing the recording apparatus. On the upper end of this vertical shaft is another bevel gear, which meshes with two gears running freely on a horizontal shaft, which will be seen in Fig. 5 projecting through the end of the case and geared to the paper driving roll. On this shaft and splined to it between the two bevel gears is a collar provided with teeth which can mesh with corresponding teeth in the hub

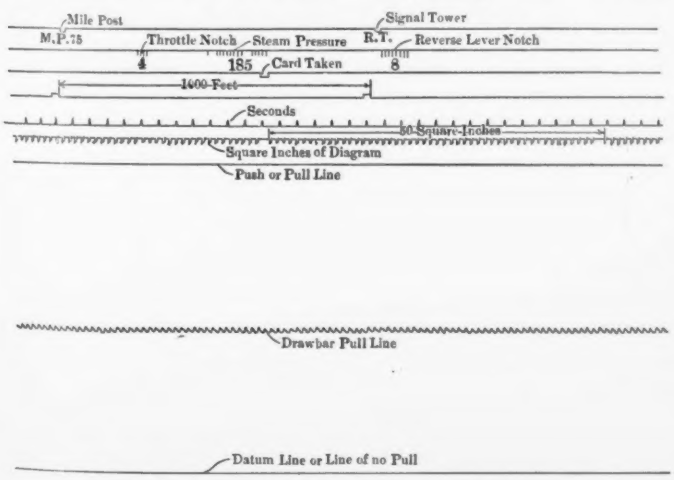


FIG. 6.—SAMPLE RECORD FROM DYNAMOMETER.

of either gear. The movement of this collar is controlled by a handle under the recording table. The adjustment is such that both gears can run free on the shaft or the splined sleeve can be meshed with either so as to drive the paper only in one direction no matter which way the car is running. The paper is carried in large rolls, the supply roll being the upper one in Fig. 5. From this the paper goes up through a slit in the table over the top and below the recording pens, and then down through a second slit in the far end, under a guide roll back underneath the table and then down vertically through the driving roll and to the receiving roll, which is friction driven and always moves fast enough to keep the paper tight. The driving roll is of bronze, with its surface slightly roughened, and has its diameter so proportioned to the diameter of the car wheels that the paper moves across the record table at the exact rate of 1 in. per 100 ft. travel of the car. A rubber roll presses the paper firmly against the driving roll, so that no slip can occur.

Fig. 6 gives a sample record which is reversed in position from the location of the paper as shown in the view of the recording table, Fig. 7. The lower, or datum, line, is made by a small wheel with its circumference in contact with an inking pad, which revolves in the opposite direction of the motion of the paper, as the paper passes beneath it. Above this is the record of the drawbar pull made by the pen on the end of the piston rod from the recording cylinder. This will be seen projecting out through the front of the glass case. Above this is the record of a pen which automatically shows whether the load on the drawbar is a push or a pull. Since the dynamometer is arranged to register on the same side of the datum line for both it is impossible to tell from the record line whether the load is forward or backward. The next record is from the mechanical integrator, the arm of which is connected to the recording pen. An electrical connection is made to the integrator wheel on the table, so that every notch in the record has a value of 1 sq. in. of area between the dynamometer record and the base line. Every fiftieth notch is skipped, so that the numbers can be quickly summed up. Since the integrator wheel usually stands at an angle to the motion of the paper it has a tendency to cause the paper to slip sidewise. To correct this an instrument, shown at the right of the integrator wheel in Fig. 7, is provided. This consists of a rubber wheel rolling on the paper, which can be set at any desired angle to counteract the influence of the integrator wheel. Beneath this rubber wheel and set in the face of the table is another wheel, the diameter of which is very carefully made so that it will have one revolution for every 10-in. motion of the paper, and by electrical connection makes a record showing the 1,000 ft. distance traveled by the car, which record is the fourth from the top in Fig. 6. The record directly below this is made by a connection to the chronometer and indicates the distance passed over by the paper at five second intervals. There are three other pens, the records of which are shown in Fig. 6. The third from the top is operated by an observer on the locomotive and records the time of taking indicator cards. The second is also operated from the locomotive and records the steam pressure and the position of the throttle and reverse levers. The upper one is operated by the observer at the lookout window, and is used to record locations of permanent objects, such as mile posts, signal towers, curves, etc. An extra or reserve pen is also provided for use in emergencies.

One corner of the paper is covered by a triangular sheet of glass, on which the operator can rest his arm while making notes without any danger of impeding the motion of the paper.

The Dynamometer.—As mentioned above, the load from the

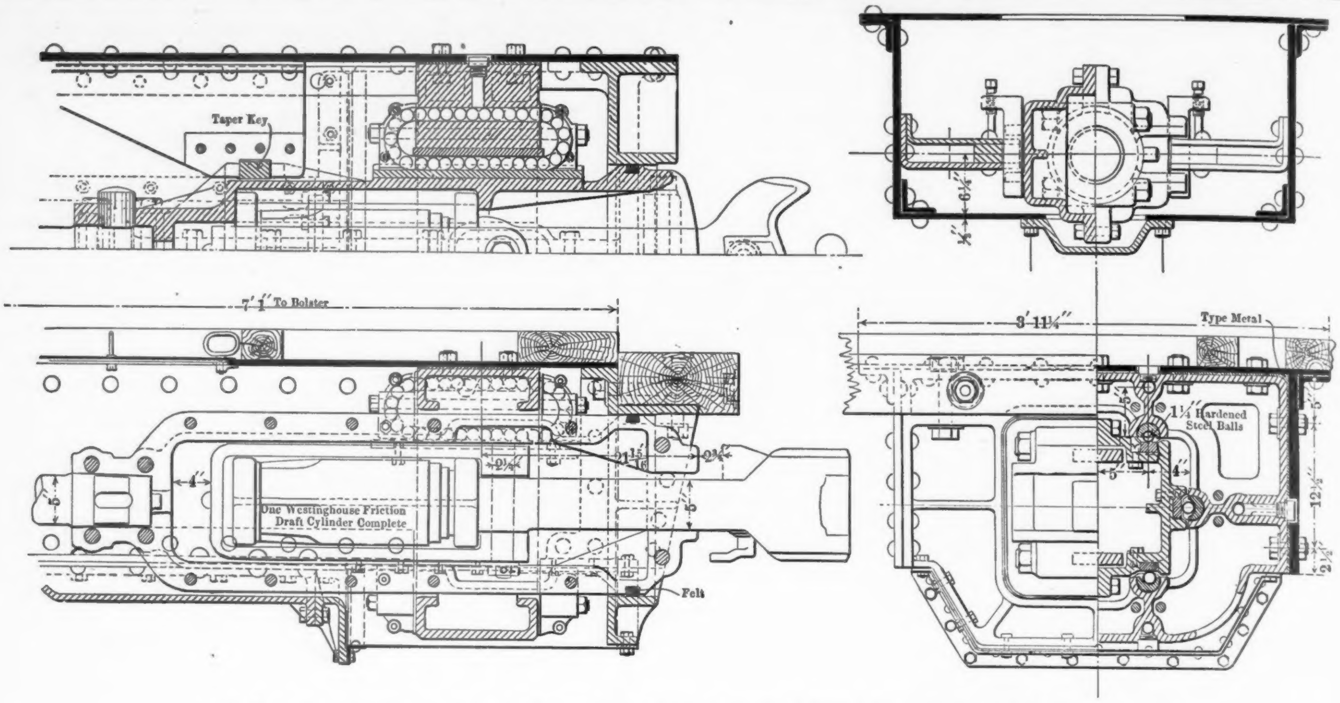


FIG. 8.—DRAFT GEAR HOUSING AND END OF CENTER SILL—PENNSYLVANIA R. R. DYNAMOMETER CAR.

drawbar is transmitted directly to the piston of the main press, and since it is desirable to get a very accurate measurement of the exact load on the drawbar, it is necessary to use all possible care in eliminating friction between the coupler and the piston. This has been done by the liberal use of a ball and roller bearing at all points of support, and in addition special arrangement has been made to keep all dust and dirt from getting access to the interior of the box girder center sills wherein the connections lie.

The coupler head is connected to a Westinghouse friction draft gear by the usual yoke. This draft gear is secured within a heavy cast steel housing, the details of which are shown in Fig. 8. This housing is carried in a frame which forms part of the center sill construction, and is supported and guided in it by a set of six circuitous ball bearings, each containing 32 hardened steel balls 1¼ in. in diameter. The bearings, or ball races, are so arranged as to have 10 of these balls constantly in contact with the housing, thus holding it in rigid alignment and practically without friction. The space between the outer end of the housing and its frame is fitted with a felt bushing. To relieve the dynamometer mechanism from all load when it is not in use provision is made for the inserting of tapered keys between lugs on the housing and its frame, so that they are rigidly held together and the load is carried directly to the sills in the usual manner.

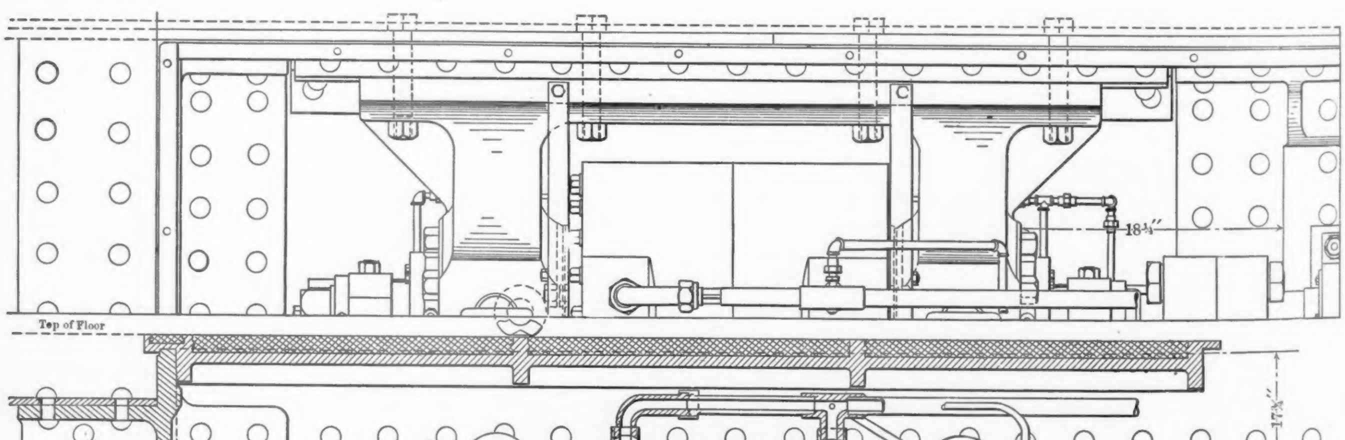


FIG. 9.—DYNAMOMETER CYLINDER OR MAIN PRESS—PENNSYLVANIA RAILROAD DYNAMOMETER CAR.

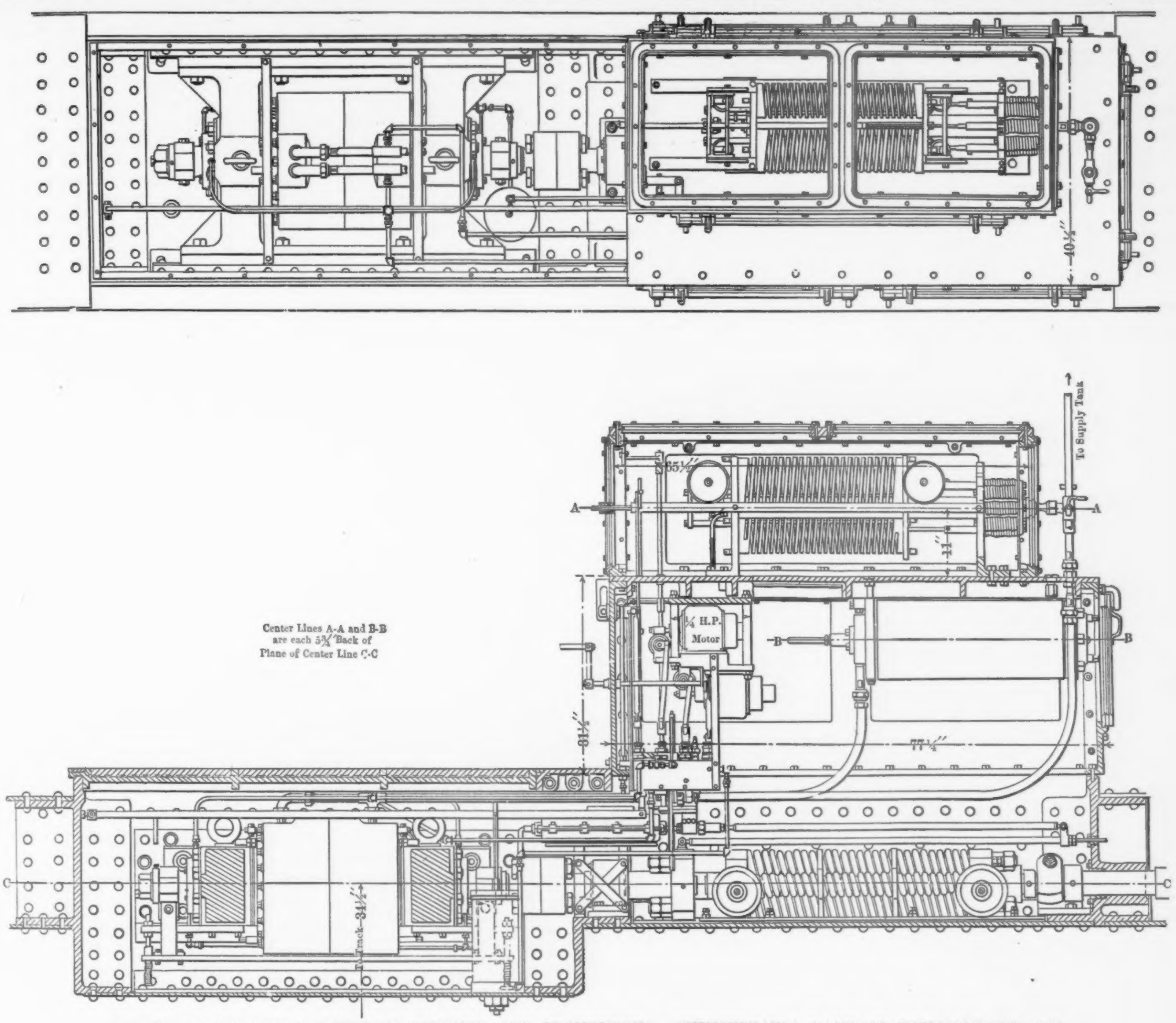


FIG. 10.—MAIN PRESS, RECORDING CYLINDER AND CONNECTIONS—PENNSYLVANIA RAILROAD DYNAMOMETER CAR.

The rear end of the housing is connected to a shaft or drawbar which about 6 ft. back passes through a cast-steel partition in which is placed a special form of stuffing box that is practically frictionless, and beyond which it connects to a spring buffer. This spring buffer is designed to take all loads above 100,000 lbs., the capacity of the apparatus. It consists of three cross heads, one being permanently fixed to the extension of the piston rod from the main press of the dynamometer, while the other two crossheads fit around the drawbar shaft and are held in place by nuts on the outer side of each. Four long bolts pass through all three crossheads and are secured in the one from the main press and are movable in the other two. There are distance or spacing thimbles around the bolts between the first and second crosshead at the left. Coil springs are fitted around the bolts between the two crossheads at the right, and by means of nuts on the ends of the bolts these springs are set with a compression of 100,000 lbs. The whole apparatus is carried on a small carriage fitted with four wheels, as is shown in the illustration. Since the springs are under compression of 100,000 lbs. all loads up to that limit will be transmitted directly through the buffer the same as if it were a solid bar. If the load increases above this, one crosshead will move away from the thimbles and the springs will compress until they have shut 1⅛″ less whatever the piston has moved from the central position, when a stop on the drawbar shaft will strike against the partition just to the right of the buffer and then any load over that necessary to compress the springs this much will be transmitted directly to the frame of the car. The same action takes place for either pulling or buffing strains.

To minimize the friction, the weight of the draft gear and its connecting rod to the piston of the main press cylinder, is carried on frictionless bearings either in the form of rockers which rotate on ball bearings or else it is carried on ball bearings with straight race-ways. That part of the box girder which contains the main press is made absolutely dust proof. Provisions have also been made to keep this compartment at as nearly a uniform temperature as possible, both winter and summer, so that a minimum variation in the viscosity of the oil will be obtained.

Fig. 9 shows the details of the main press and Fig. 10 illustrates its connections to the recording cylinder. The construction will be seen to be very heavy and since it is necessary to eliminate friction as far as possible and as the leakage allowance is very small, it is necessary to make some provision for carrying the weight of the piston and its rod so as to prevent wear of the bushings in the end of the cylinder and allow a close fit without friction. This has been done by means of a support at either end outside of the cylinder, consisting of rocker arms bearing on a flat support which is carried by four springs from the main cylinder housing. The rocker arms at their upper ends carry a cross shaft fitted with roller bearings on which the piston rod rests. By adjustment of the springs supporting the carrying plate it is possible to just relieve the weight of the piston from the bushings.

The piston itself is 16¼ in. in diameter and is 8 in. long. It is carefully fitted to the cylinder and is grooved with a spiral groove on its periphery to secure lubrication and avoid the use of packing. The cylinder itself is made of gun iron in two parts fitted together as shown in the illustration.

Since it is necessary for the dynamometer to register in either

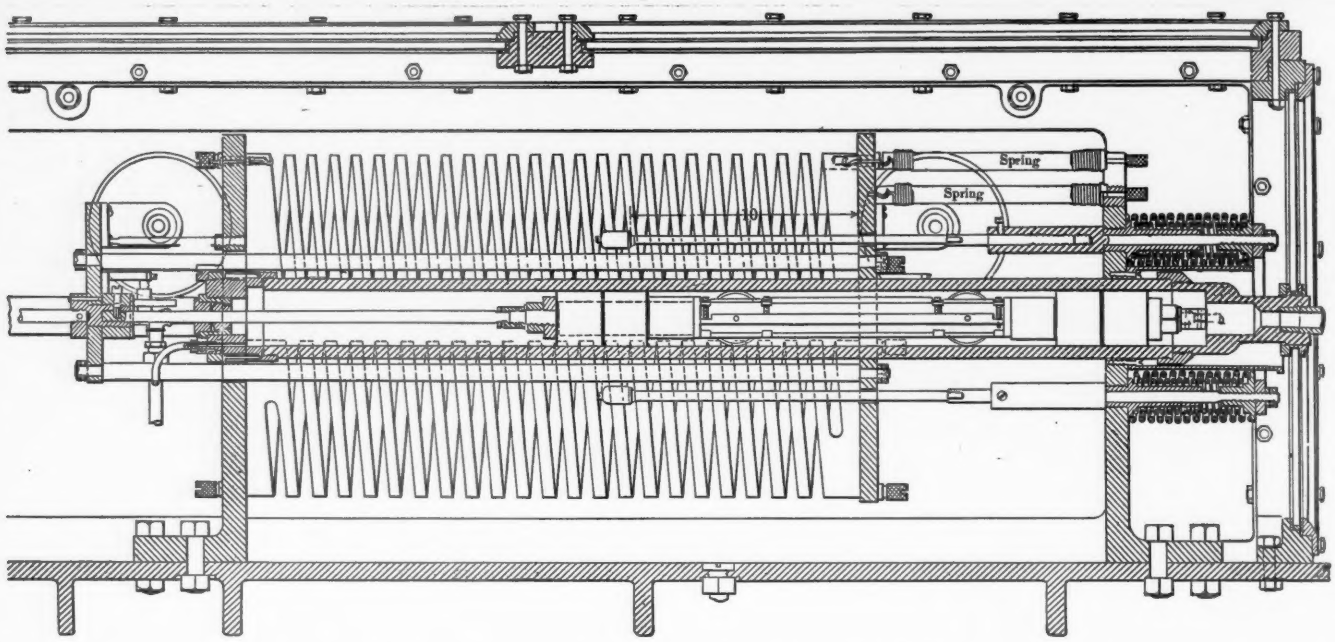


FIG. 11.—DETAILS OF RECORDING CYLINDER—PENNSYLVANIA RAILROAD DYNAMOMETER CAR.

direction, automatic valves have been arranged so that when the piston is in the exact center the valves leading to the recording cylinder and the supply tank are both slightly open and the whole apparatus is in equilibrium. A slight movement in either direction, however, will close the valve to the supply tank on the side toward which the piston moves and open the valve leading to the recording cylinder, while on the opposite side the reverse takes place, thus while either side of the piston is compressing the liquid into the recording cylinder the other is always open to the pressure from the supply tank.

Fig. 11 shows a cross section of the recording cylinder and Fig. 12 is a view of this cylinder with the springs in place, and also shows the recording piston with its rod and carriage on the table in the foreground. The recording cylinder, which is connected by an oil pipe at the back end through the cooling cylinder directly to the main press, is 40 in. long and 2 17/32 in. in diameter. It has a piston area equal to about 1/36 of that of the main press. Since it is even more necessary to eliminate friction at this point than in the main press extreme care has been taken in the design of the piston and cylinders so as to allow perfectly free movement and to prevent all possible wear while at the same time making the leakage so small as to be negligible. For this purpose four pistons are provided in pairs, each pair being fastened to the end of a long arbor. This arbor is provided with a pair of rollers whose axles are carried in two side bars, thus forming a small truck which carries the arbor and piston. Eight springs which are interposed between the wheels and the truck can be accurately adjusted so as to just support the weight of the moving parts. The ends of the recording cylinder are supported by plates, which also carry two rectangular bars, forming a track for a four-wheel truck. Extending from the arbor carrying the piston is a small piston rod, which connects to a crosshead forming the forward end of the truck just mentioned. The rear end of this truck is formed by another crosshead, the connection between the two being made by four rods, which pass freely through openings in the forward stanchion supporting the recording cylinder. The recording springs are placed between the rear crosshead of the truck and this front stanchion. The piston rod is carried on beyond the crosshead and through the glass case which encloses all of this apparatus and on its end carries the pen for making the record. The recording springs are fastened in place by thumb screws and are of special construction, which will be mentioned later.

In order to prevent any possibility of accident to the recording springs in case too light springs are in place for the load on the main press, a spring buffing arrangement is attached back of the rear stanchion, and so connected as to come into action when the carriage has made a movement of 10 in., the limit of travel of the pen. Springs are used for this purpose in place of solid stops, because of the possibility of the throttling device between the main press and the recording cylinder being left open when light springs were in place and a sudden load which might come upon the machine would then force the piston out very rapidly and make it inadvisable to bring it against a solid stop. The construction of this apparatus is clearly shown in the illustration.

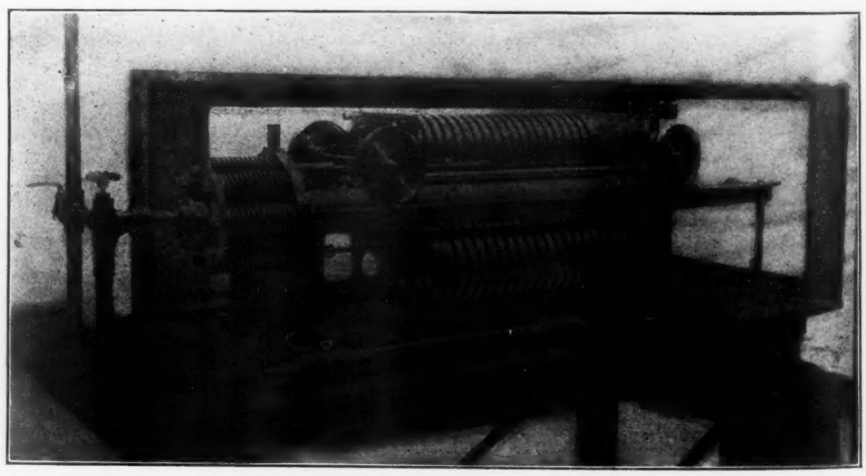


FIG. 12.—VIEW OF RECORDING CYLINDER, SPRINGS AND SPRING BUFFER.

The manufacture of the springs to resist the movement of the recording piston, which must be capable of giving exactly the same movement per increment of load for any point during a compression of 10 in., required a large amount of study and experimentation. After several failures and much tedious labor, the problem was solved by making the springs in the following manner: A drum of nickel steel was rough turned to the desired outside and inside diameter and cut off to the proper length, and was then hardened in an oil bath. After being hardened it was turned and bored to the exact size, carefully fitted to a mandrel and a spiral groove was cut through the drum, starting

near one end and stopping near the other, leaving a spring of square section with solid ends. This was then carefully tested and ground on the outside until it would give exactly the same movement under the same increase of load at any point in a compression of 10 in. for any number of applications. In fact, so accurate was this work that its probable error in 10 in. is only about 1/1000th of an inch. The difficulty attending this work will be understood when it is stated that after the drum was hardened it, in some cases, took two days to drill a 7/16 in. hole 5/8 of an inch deep in the drum. The threading of one drum took 27 working days to finish. There was but one kind of tool steel which was found capable of doing this work and that would only operate when given special heat treatment and required constant sharpening. The springs are 27 in. long and vary from 5.6 to 7.3 in. outside diameter. They weigh from 29.4 to 58.6 lbs. each. The smaller ones, of course, being the ones used for the larger movement of the pen under lighter loads.

For supplying oil to the cylinders and to take care of all leakage past the piston a complete system of tanks, piping and pumps has been provided. The large supply tank, shown near the roof

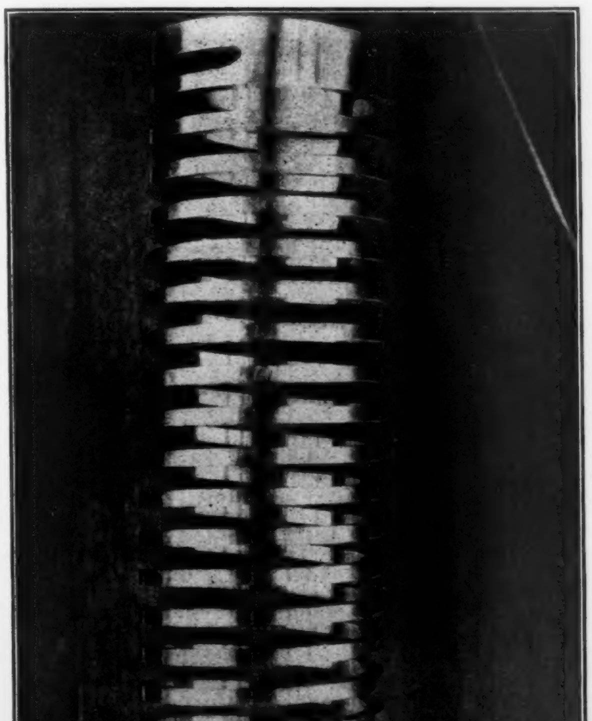


FIG. 13.—ONE OF THE SPRINGS.

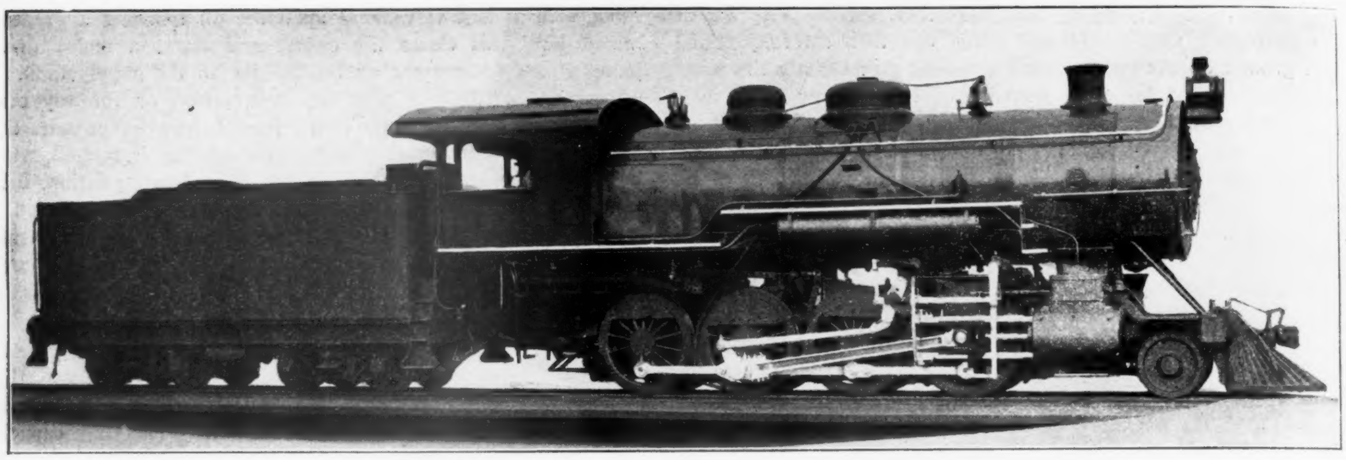
of the car in Fig. 4, is connected directly to the valves in the main press. Interposed between the main press and the recording cylinder is a cooling cylinder on the end of which is a needle valve which can be controlled from the operating table and is used to throttle the passage of the oil to the recording cylinder. If necessary, this valve can be closed, thus cutting off the recording mechanism altogether.

The leakage past the piston of the recording cylinder, as well as that through the piston rod glands of the main press, is conducted through a system of pipes to the leakage tank, which is fitted with a float valve, and upon the oil reaching a predetermined level this closes the circuit and starts a motor driven pump which returns the excess leakage to the supply tank. If on account of leakage past the main piston or for any other reason this piston leaves the center line of the cylinder more than 5/8 of an inch another electrically driven pump is started, which will force the piston back to within 5/8" of mid-position, being capable of working against the maximum pressure exerted by the main press. Both of the electrical pumps are supplemented by hand pumps, and there is an electrical alarm which sounds when anything goes wrong with the electrical pump.

AVERAGE LOAD IN BOX CARS.—It is a question whether railroads exercise their best judgment in building their equipment upon the single basis of carrying capacity instead of on the double basis of cars and carrying capacity. Too many high-capacity cars have been built in recent years, as shown by the small average load; and in view of the fact that there have been relatively few changes in classification. In order to demonstrate the truthfulness of this as relates to box cars, some figures were prepared covering the business of the busiest months of the Erie Railway, and it was found that, exclusive of merchandise, the average load placed in a 60,000-lb. car was 15 tons; in a 70,000-lb. car, 21 tons; in an 80,000-lb. car, 21½ tons.

It will be noted that the average load would utilize less than half of the carrying capacity of the 40-ton box car, and about two-thirds carrying capacity of the 30-ton box car. During the last fiscal year, the Erie Railway handled 1,120,000 loaded box cars. Of this number 470,000 were loaded with merchandise, which averaged 12,000 lbs. a car, and 650,000 were loaded with freight other than merchandise, which averaged 41,000 lbs. If the Erie Railway could have had its choice of 30-ton cars or 40-ton cars, in which to handle all freight requiring box cars, during the last fiscal year, a saving of $312,000 would have been effected in the cost of operation by the use of the smaller car, the lesser weight of the smaller car making this possible. Heavy capacity cars are operated economically when used for handling specified commodities of great specific gravity, such as tidewater coal and ore.—*Mr. C. C. Riley before the New York Traffic Club.*

POWER FACTOR IN RAILROAD SHOPS.—The percentage of generator capacity to the sum of the rated motor horse-powers is somewhat uncertain, but it is lower perhaps than generally imagined. At the 1903 convention of the Master Mechanics' Association a committee reporting on electrically driven shops stated that 40 per cent. of the aggregate horse-power of the tools could be taken, and to this added the constant and average lighting load in order to determine the capacity of the generators required, without including in the list of such motors those required for cranes, transfer tables or turntables, but that the question of a spare unit should always receive consideration. The Master Mechanics' proceedings for 1900 stated that at the Baldwin Locomotive Works, the switchboard load averaged only about 27 per cent. of the total motor rating, in this case the crane motors being included. At the Topeka shops a switchboard load equal to 38 per cent. of the various motors, exclusive of those on the cranes, was found to obtain. At the McKee's Rocks shop the power consumption was about 30 per cent. of the motor rating. The actual installation of some large and modern shops is very interesting. At Collinwood the total generator capacity (after deducting requirements for lights) was 50 per cent. of the sum of the motor ratings, not counting those upon the cranes. At McKee's Rocks shop it was 47 per cent. on the same basis; at the Angus shop, Montreal, 37 per cent. The new Parsons shop of the M. K. & T. Ry. has a generator capacity of about 75 per cent. of the total rated motor capacity. Of course the question of the size of generators and also spare units affects this to a certain extent, and the best way to study the question is to lay out a hypothetical load diagram and determine from this the most economical size of units.—*Mr. G. R. Henderson at the New England Railroad Club.*



SIMPLE CONSOLIDATION LOCOMOTIVE WITH BALDWIN SUPERHEATER.

SIMPLE CONSOLIDATION LOCOMOTIVE

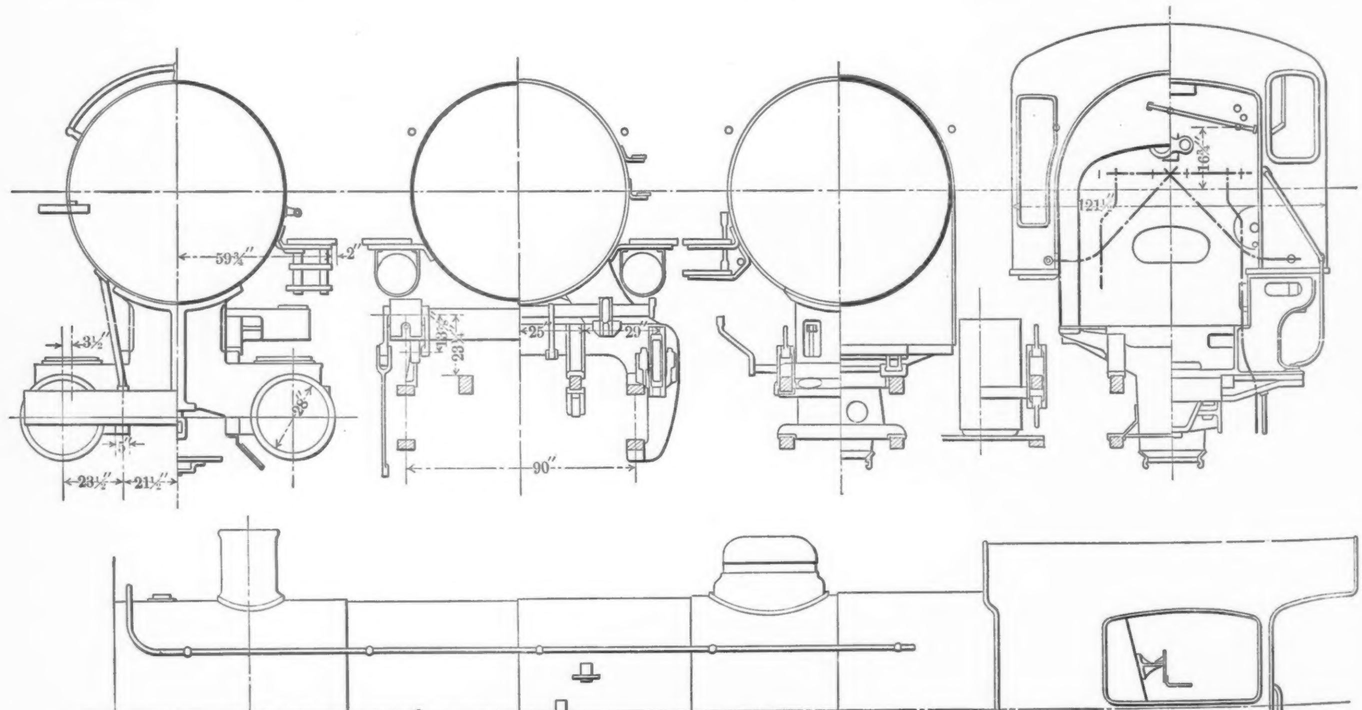
FITTED WITH BALDWIN SUPERHEATER.

The Baldwin Locomotive Works has recently completed a very interesting simple consolidation locomotive which will form part of its exhibit at the Jamestown Exhibition.

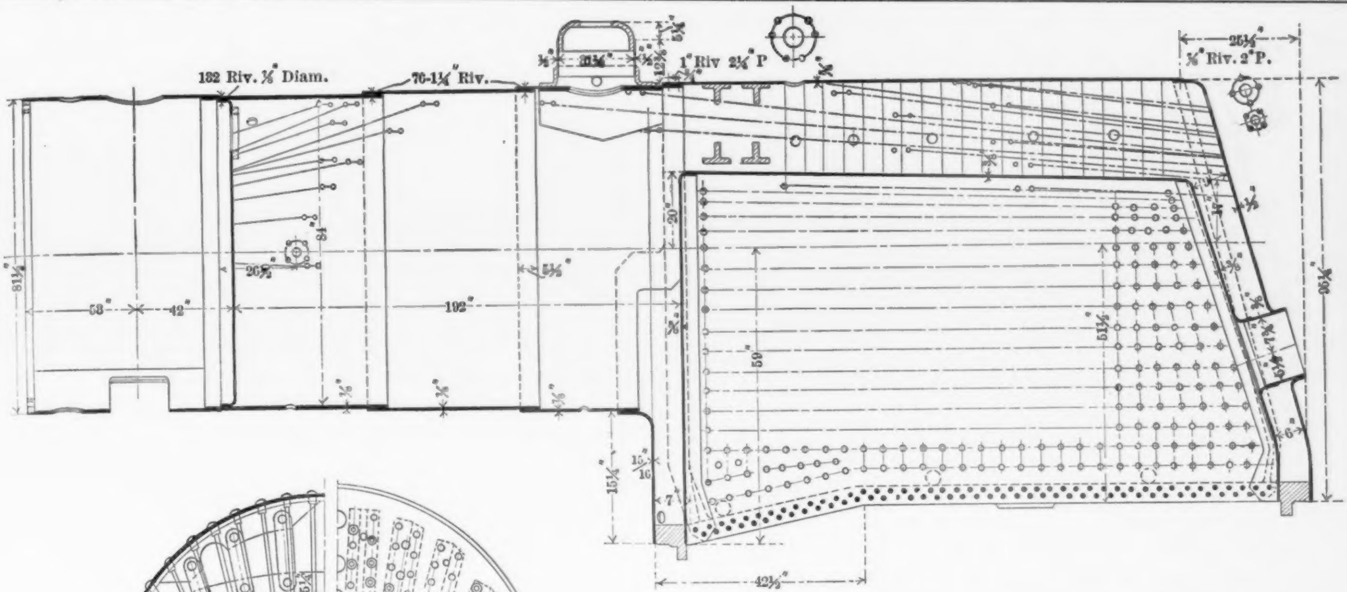
This is the heaviest locomotive of its type ever built, and shares with the Santa Fe type, recently built by the same company for the Pittsburg, Shawmut & Northern Railway,* the distinction of having the largest simple cylinders ever applied to a locomotive. Like that locomotive also it carries but 160 lbs. steam pressure, and is fitted with the Baldwin design of smoke-box superheater. The boiler is 84 in. diameter at the front end and has 472 2-in. flues, making it one of the largest ever applied to a locomotive of any type designed for regular road service.

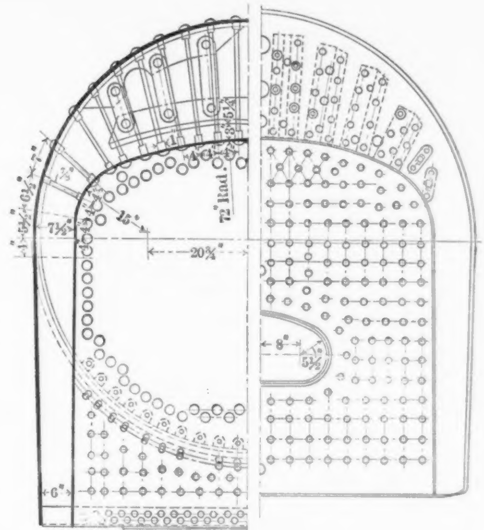
The locomotive weighs 260,1000 lbs., of which 232,700 lbs., or 89 per cent., is on the drivers. This gives a weight of 58,175 lbs. per axle, which we believe is the greatest weight ever put on one pair of locomotive driving wheels. The main journals are 11 x 12 in., and the others are 10 x 12 in. The next heaviest locomotive of this type on our records is the one on the P., B. & L. E., built in 1900, which weighs 250,300 lbs. total, and 225,200 lbs. on drivers, giving a weight of 56,300 lbs. per axle. The main journals are 10 x 13 in., the others being 9 x 13 in. This is followed by those on the Delaware and Hudson Company's line (AMERICAN ENGINEER, January, 1907, page 22), which weighs

* See AMERICAN ENGINEER AND RAILROAD JOURNAL, March, 1907, p. 88.



ELEVATIONS AND SECTIONS OF SIMPLE CONSOLIDATION LOCOMOTIVE WITH BALDWIN SUPERHEATER.





BOILER OF BALDWIN CONSOLIDATION LOCOMOTIVE.

246,500 lbs. total, and 217,500 lbs. on drivers, giving a weight of 54,375 lbs. per axle, the journals all being 10 x 12 in.

The cylinder castings, as can be seen in the illustrations, are simple in design, with heavy walls and double bolted flanges. The front frame rails are 5 in., wide, and have keys at the front only. The cylinder diameter is 28 in., and the stroke is 32 in. This is equivalent to a 25 x 32 in. cylinder, with 200 lbs. steam pressure. The increase in area of cylinder walls of the 28 in. over the 25 in. cylinder is 304 sq. in. in each cylinder, or over 12 per cent. With saturated steam this would be a matter requiring careful consideration, but as superheated steam is used in this case the condensation loss from the increased area is probably more than overcome by the reduction in leakage and by the increased amount of superheat which can be given to steam of 160 lbs. pressure (370°) over that at 200 lbs. pressure (389°). To insure adequate lubrication a five-feed lubricator is provided and a separate feed is carried to the pistons, being tapped in at the center of the cylinders.

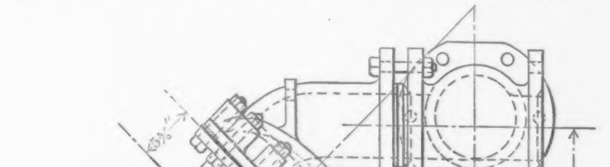
The boiler, as is shown in the illustration, is of the straight type and measures 84 in. diameter at the front end. The firebox is radially stayed and the cast steel mud ring is six inches wide on all sides. The boiler is designed for 200 lbs. pressure, although but 160 lbs. is being carried. There are 472 2-in. flues 16 feet long, which give a heating surface of 3,931 sq. ft. The firebox heating surface of 198 sq. ft. is but 4.8 per cent. of the total.

The main frames are cast steel 5 in. in width throughout and fitted with pedestal binders of the well-known clip design. The equalization system is broken between the second and third pairs of driving wheels. The use of the Walschaert type of valve gear permits a very efficient system of frame bracing.

The valve gear drives the outside admission slide valves through a rock shaft with two arms, the inner connecting to the valve stem and the outer to the combination lever. This permits the valve center to be thrown 3½ in. inside the cylinder centers. The arrangement and design of the valve gear is clearly shown in the illustrations. The M'Carroll air reversing mechanism * is used.

The smokebox superheater fitted to this locomotive is similar in every way to the one used on the Shawmut locomotive mentioned above and reference can be made to the description of that locomotive for the arrangement of this device in the front end. The illustration of one of the sections shown herewith gives an idea of the general construction. It consists of an upper and lower cast steel header on either side, between which are a large number of small steel tubes curved to the contour of the smokebox. These pipes are divided into groups and the passages in the headers are so arranged as to compel the steam in passing to the cylinders to transverse the different groups of superheater pipes and thus be held in contact with the front

* See American Engineer and Railroad Journal, Oct., 1906, p. 375.



SUPERHEATER SECTION—BALDWIN SUPERHEATER.

end gases, which, by the proper arrangement of deflected plates, all pass the superheating tubes as soon as they emerge from the flues; a sufficient length of time to attain a fair degree of superheat. The large size of the front end in this locomotive permits a superheater with 834 sq. ft. of surface to be installed without difficulty. The outside of the front end is heavily lagged.

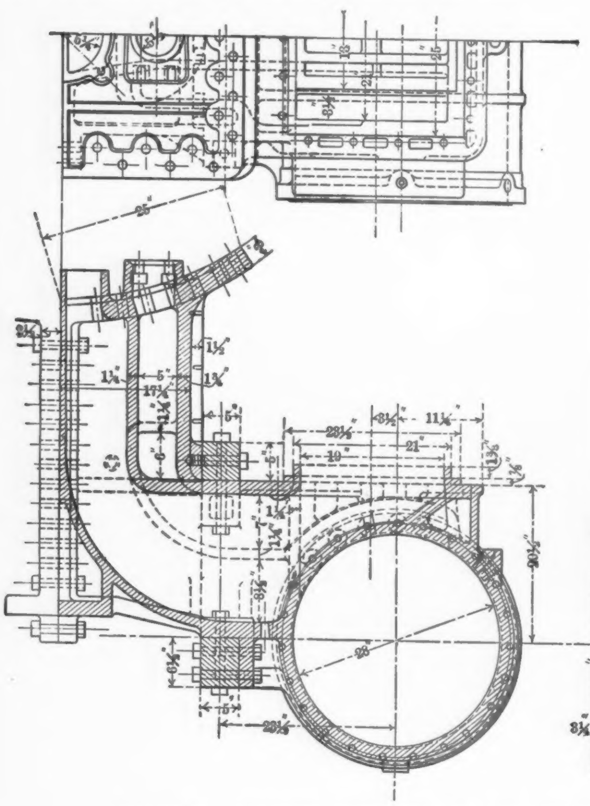
The general dimensions, weights and ratios are as follows:

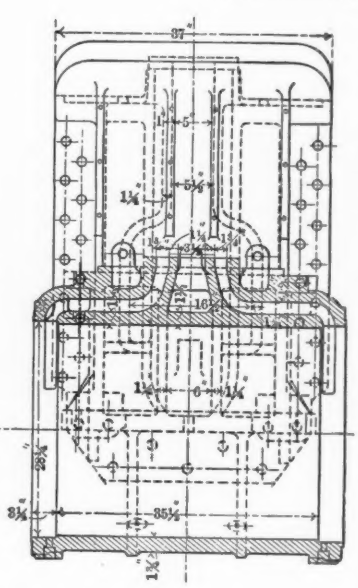
GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Freight
Fuel	Bit. Coal
Tractive effort	54,100 lbs.
Weight in working order	260,100 lbs.
Weight on drivers	232,700 lbs.
Weight on leading truck	27,400 lbs.
Weight of engine and tender in working order	422,000 lbs.
Wheel base, driving	17'
Wheel base, total	26' 6"
Wheel base, engine and tender	60' 10"

RATIOS.

Weight on drivers ÷ tractive effort	4.3
Total weight ÷ tractive effort	4.8
Tractive effort × diam. drivers ÷ heating surface	825.0
Total heating surface ÷ grate area	68.5
Firebox heating surface ÷ total heating surface, per cent	4.8





CYLINDERS—BALDWIN CONSOLIDATION LOCOMOTIVE WITH SUPERHEATER.

Weight on drivers ÷ total heating surface	56.0
Total weight ÷ total heating surface	63.0
Total heating surface ÷ superheating heating surface	4.95
Volume both cylinders, cu. ft	22.7
Total heating surface ÷ vol. cylinders	181.0
Superheating heating surface ÷ vol. cylinders	36.8
Grate area ÷ vol. cylinders	2.65

CYLINDERS.

Kind	Simple
Diameter and stroke	28" × 32"
Kind of valves	Bal. Slide
Type of valve gear	Walschaert

WHEELS.

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 × 12 in.
Driving journals, others, diameter and length	10 × 12 in.
Engine truck wheels, diameter	36 in.
Engine truck, journals	6 × 12 in.

BOILER.

Style	Straight
Working pressure	160 lbs.
Outside diameter of first ring	84 in.
Firebox, length and width	120 × 72¼ in.
Firebox plates, thickness	⅜ and ⅝ in.
Firebox, water space	6 in.
Tubes, number and outside diameter	472—2 in.
Tubes, length	16 ft.
Heating surface, tubes	3,931 sq. ft.
Heating surface, firebox	198 sq. ft.
Heating surface, total	4,129 sq. ft.
Superheating heating surface	834 sq. ft.
Grate area	60.2 sq. ft.

TENDER.

Wheels, diameter	33½ in.
Journals, diameter and length	5½ × 10 in.
Water capacity	9,000 gals.
Coal capacity	15 tons

SOME NOTES ON THE TESTS AT THE ST. LOUIS EXPOSITION.*

By H. H. Vaughan.

The tests give a large amount of data as to the efficiency of the evaporating surface, but it does not seem possible to separate this entirely from the efficiency of the furnace. By this I mean that, knowing the composition of the flue gases, their firebox and smokebox temperatures, it should be possible to calculate the exact amount of heat transmitted to the flues, but although I have spent a large amount of time on this subject the results were of practically no value. Probably a thorough study would afford some results, but the work is very tedious and the results were not sufficiently encouraging to induce me to devote the time required. Taking the results of boiler and furnace together there are, however, some interesting results, justifying as a whole the use of a large boiler. Neglecting 2512, which was fitted with Serve tubes, the total heating surface (based on fire side of tubes), and grate area was as follows, arranged in order of heating surface:

Engine No.	Heating Surface.	Grate Area.
628	1,753 square feet	29.1 square feet
1499	2,482 square feet	49.2 square feet
734	2,541 square feet	33.8 square feet
585	2,812 square feet	49.4 square feet
535	2,902 square feet	48.4 square feet
3000	3,000 square feet	49.9 square feet
929	4,306 square feet	58.4 square feet

Excepting, therefore, 628 and 929, there was not a great deal of difference in the amount of heating surface in the engines tested, but 1499 and 734, with about 2,500, should show differences as compared to 535 and 3000, with about 2,950, or say an increase of 20 per cent. in the heating surfaces

The relative value of heating surface should be demonstrated in one of two ways. If heating surface is of the same value, however disposed and of whatever extent, then the evaporation per pound of coal should be the same when equal amounts of coal are burnt per square foot of heating surface per hour. As a test of this I have prepared Fig. 1, showing the equivalent evaporation per pound of dry coal plotted with reference to the dry coal fired per square foot of heating surface per hour. This diagram differs only from that shown in the P. R. R. report by showing the individual values for each test in place of curves dawn through those values. The heavy dotted line is the curve

$$E\left(1 + \frac{R}{2}\right) = 14,$$

where E is the equivalent evaporation per pound of dry coal, and R the pounds of dry coal burnt per square foot heating surface per hour, and it will be seen to be an excellent average of the various results. From this diagram it would appear that the heating surface question was settled, and it would naturally follow that for any given amount of coal burnt a boiler having large heating surface should evaporate considerable more water than one with less. To exhibit this I have plotted Fig. 2, which shows the total evaporation per hour plotted with reference to the pounds of dry coal burnt per hour, from which it will be seen that the results are almost contradictory, as the 50 per cent. increased heating surface of 929 shows no greater evaporation than 585, 535, or 3000.

An inspection of Fig. 1 will show the reason of this apparent discrepancy; for instance, a curve drawn through 929 would intersect the 10.5 lb. evaporation line at about 0.45, while that for 3000 is about 0.67, and for 585 about 0.75. In other

* From a paper presented before the Canadian Railway Club, April, 1907.

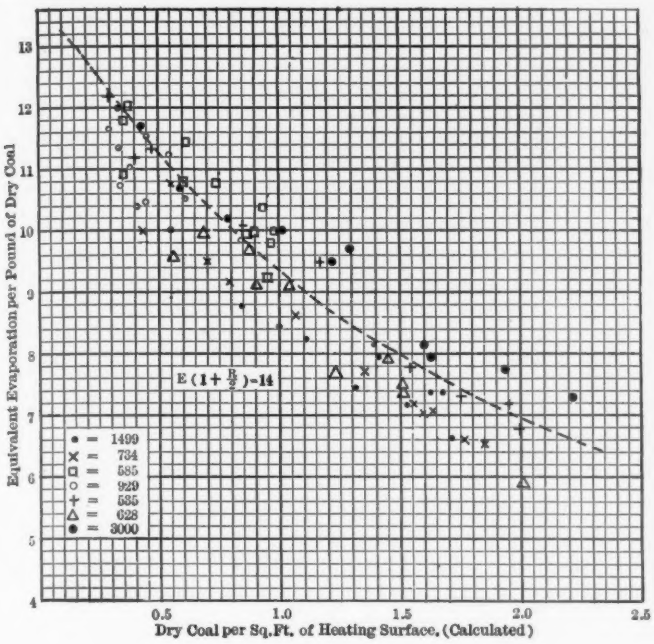


FIG. 1.

words, while the various results are at first sight well grouped, there is sufficient variation between them to entirely correspond with Fig. 2. The question then arises whether Fig. 1 is to be trusted, and the writer believes that further investigation shows that it is, and that factors other than heating surface are responsible for is peculiarities, for the following reasons: The points for 3000, which had the largest heating surface of any engine but 929, mostly lie well above the curve, while those for 535 are almost exactly on it—those for 1499 and 734 generally below it, although several of the former agree almost exactly with it—those for 628 are in general below it—and 585 are above it. These facts show that, with the exception of 929, the engines with the largest heating surface show at least the same and generally greater efficiency than those with the smaller, and if this be so the diagram is justified. The variations must in all probability be looked for in the firebox, and this, I think, explains the specially good results obtained from 3000 at high rates. The firing, while uniformly excellent, was undoubtedly governed somewhat by the demands on it. When the boiler was not so much pressed, the thickness of the fire was not always the best, leading to excess of air or the opposite fault, formation of CO, and this in turn exercised an influence on the results that is almost impossible to accurately measure. The low results of 734 can, of course, be explained by its being a narrow firebox engine, and as for 929 it must be remembered that this engine was never worked to anything like the capacity of its boiler, and it showed a very high percentage of CO, considering the coal burnt per square foot of grate. It does not seem justifiable from the results obtained from this engine to

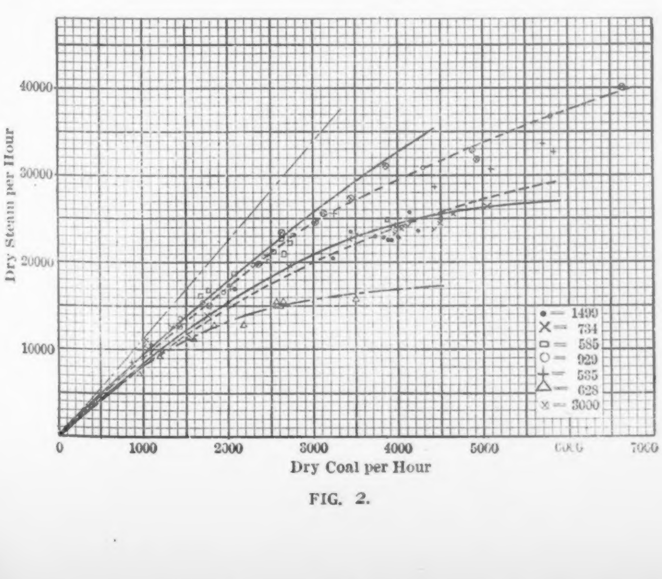


FIG. 2.

dispute the general agreement of the other tests, and it therefore appears safe to consider that the curve drawn represents very closely the evaporation results that will be obtained from a boiler with first-class firing and average conditions otherwise.

It will, perhaps, be as well to take this opportunity to refer to a paper which I read some three years ago on the question of heating surface, and in which I now believe I drew some entirely erroneous conclusions. The value of heating surface was shown to be proportional to the square root of the length of the tubes, in place of their length. In one sense this is true. For instance, if with 1,000 feet of heating surface coal was burnt at the rate of 2,000 lbs. per hour the evaporation would, by Fig. 1, be 7 lbs. If the heating surface were doubled the evaporation would be 9.3 lbs., or 1.33 times as great. Now, as the square roots of 1000 and 2000 are in the proportion of 1.41 to 1.00, there was sufficient truth in this to lead to an attractive fallacy, and, in fact, this was really shown in the discussion. Where the mistake was made was in trying to extend this idea to cover the form of the heating surface, whether in a number of short tubes or a lesser number of long ones, and trying to show that the latter were less efficient. This, I am now convinced, was wrong, as the fact was overlooked that if the number of tubes is decreased the amount of gas and, consequently, of heat through each tube is correspondingly increased. On the assumption that the heat transferred per square foot is proportional to the difference in temperature between the flue gases and the water, this may be shortly demonstrated as follows:

Take two boilers, one with n flues a feet long, the other with m flues b feet long, and let na = mb or the heating surfaces be equal.

Let C = circumference of tube in feet = heating surface per foot of length.

Let T = initial temperature of gases, and t, temperature at

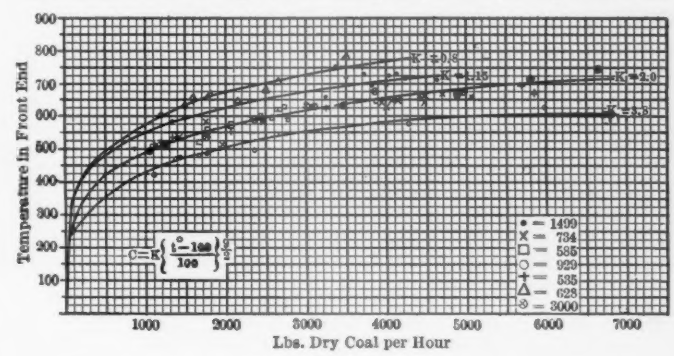


FIG. 3.

any point l feet from the end, above the temperature of the water.

Then in general $\frac{dt}{dl} = -Knct$ or $\log t = -Kncl + C$.

When $l = o$, $t = T$, and $C = \log T$.

Then $\log \frac{T}{t} = -Kncl$, and when $l = a$ and $t =$ final temperature

$$\log \frac{T}{t} = -Knca, \text{ and if } na = mb = \log \frac{T}{t} = -Kmbc.$$

Therefore, for equal areas, t is equal.

The results from 929, which had the longest flues tested, might be taken as an indication that long tubes are less efficient than short ones, but this is an isolated case, and the results from the other engines do not support it in the least. Arranging the engines in the order of the length of the tubes, they are 929, 535, 3000, 585, 734, 628, 1499, and an inspection of Fig. 1 shows that there is not the least evidence for supposing that the length has anything whatever to do with it. This is confirmed by plotting the smokebox temperatures with reference to the coal burnt per hour, which is shown in Fig. 3. In place of drawing straight lines through the points, curves are shown of the form

$$C = K\left(\frac{t^\circ - 100}{100}\right)^{2/3}$$

which fits the case almost exactly and passes through zero coal at 100° Fahr. From these curves it will be seen that the temperature of the gases passing into the front-end of 929 at 4,500 lbs. per hour was less than for the other engines at 3,000 lbs. per hour, so that it is evident that the heating surface did its part, and that the cause for the discrepancy must be looked for elsewhere. The conclusion would, therefore, be that the curve shown on Fig. 1 represents with reasonable accuracy the average result to be obtained under good conditions.

There are a number of other interesting facts to be learned from these tests, but they require, as a rule, considerable study to extract them, and in many cases they are extremely difficult to trace out. As an example, why should the boiler of 585, which shows the lowest firebox temperatures, form usually no CO and be so efficient? And in the one case when its efficiency drops off the firebox temperature is higher, but the draft is for some reason lower than usual in proportion to the steam used. Such an occurrence might be accidental, or it might be due to some cause that a careful examination would detect. Broader questions are open for study, the frictional loss, the effect of counterbalancing, the value of Serve tubes, the reason for the decreased economy of the two-cylinder compound at high speed as compared with the four-cylinder, the effect of excess of air in the firebox, and numerous others that will suggest themselves to you, but these I am not in a position to discuss, and probably would not be even did time permit. One thing more that I wish to say, and that is that we should all realize the debt we owe the Pennsylvania Railroad for its broad-mindedness and generosity in carrying out such a series of tests, and the light they have thrown on that most complicated and contradictory of man's inventions, the steam locomotive.

Timber Supply of the United States.—A recent circular of the U. S. Forestry Service, which deals with the timber supply of the United States contains some remarkable statements. As an instance, it states that every person in the United States is using over six times as much wood as he would use if he were in Europe. The country as a whole consumes every year between three and four times more wood than all the forests of the United States grow in the meantime. The average acre of forest lays up a store of only 10 cubic feet annually, whereas it ought to be laying up at least 30 cubic feet in order to furnish the products taken out of it. Since 1880 more than 700,000,000,000 feet of timber have been cut for lumber alone. It is pointed out in the circular that the increase in population since 1880 is barely more than half the increase in lumber cut in the same period. Two areas supplying timber have already reached and passed their maximum production—the Northeastern States in 1870 and the Lake States in 1890. To-day the Southern States, which cut yellow pine amounting to one-third the total annual lumber cut of the country, are undoubtedly near the maximum. The Pacific States will soon take the ascendency. At present but one-fifth of the total forest area of the United States is embraced in National Forests. The remaining four-fifths have already passed or are most likely to pass into private hands.

The Chicago Tunnel System for handling freight, mails, etc., will probably soon be doing a large freight business, as it is reported that contracts have been made with 26 railways for the handling of their freight between the business district and the several freight stations. There are now about 30 miles of tunnel with narrow gauge tracks, operated by electric motors, and mails are now carried in this way between the railway stations and the post-office. Large establishments have spur tracks built into or beneath their basements, and six stations for the use of small shippers are being established in the business district. These are served by elevators.

VALVE ELLIPSE INDICATOR.

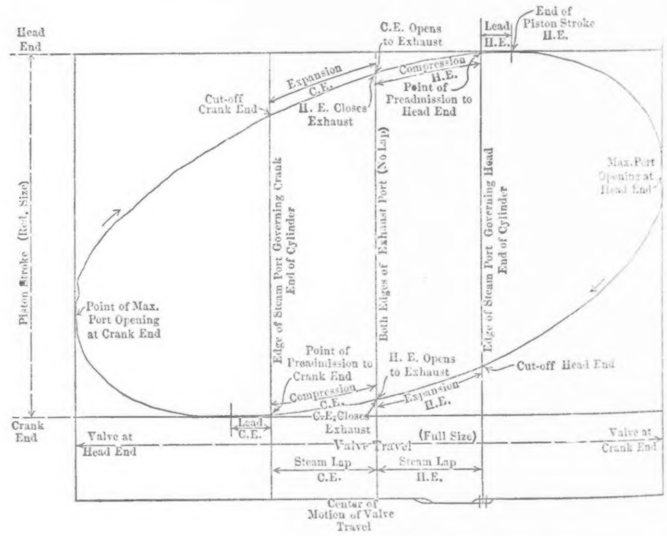
A valve ellipse is a diagram showing the position of the valve on its seat and the location of the piston in the cylinder at all times during the double stroke of a locomotive or stationary steam engine. Such diagrams are often constructed on drawing boards preliminary to erection or valve setting of an engine and are of much value in studying the proper adjustment of the valves, etc.

There have also been instruments made with which the ellipses are drawn by pencils attached to the piston and valve of the engine itself after the valves were set. The instrument of this kind shown in the illustrations is one designed by the Baldwin Locomotive Works and used by them to study valve setting on locomotives. The general ideas incorporated in this instrument were first used by Prof. Lanza of the Massachusetts Institute of Technology.

The paper on which the diagram is drawn is placed on the large drum in the same way as on a steam engine indicator and the drum is rotated by the movement of the valve. This is accomplished by attaching the chord from the drum to a standard firmly clamped to the valve stem. A pencil carried in a guide parallel to the axis of the drum is attached to a reducing motion from the crosshead so that it can be given a movement of about 3 in. from any length of stroke of the engine. A second pencil attached to this guide is given a very small movement parallel to the axis of the drum by an electric magnet in which the circuit is completed when the valve just closes one of the steam ports. The guide carrying the two pencils is movable parallel to itself, towards and away from the drum, so that the pencils do not mark on the paper until it is so desired.

The instrument is made to be self-contained in order that it may be quickly applied to a locomotive.

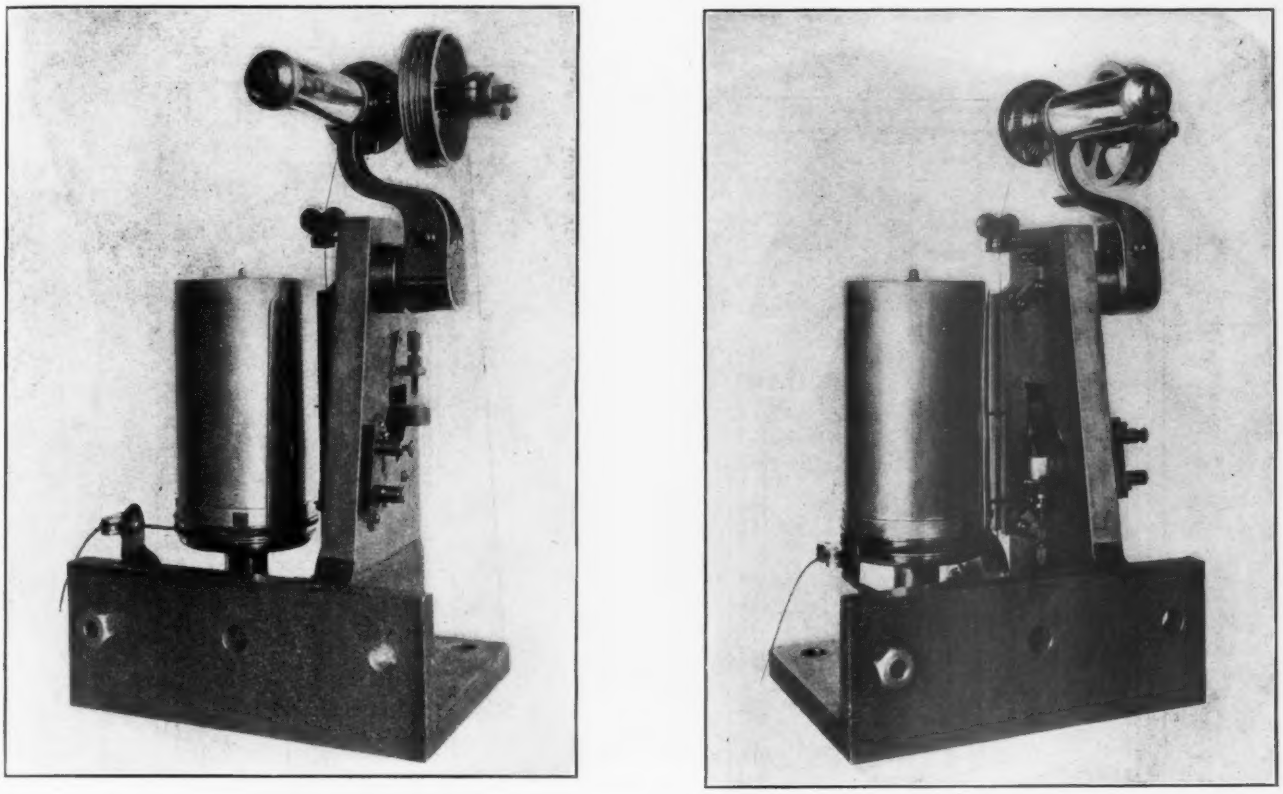
The usual procedure is to build a small wooden platform over the steam chest, either longitudinal or inclined. The valve ellipse indicator is then bolted to this platform in such a position that the string from the reducing wheel can be led to the crosshead with the use of the fewest possible pulleys. Also it must be possible to run the string from the drum directly to a standard clamped to the valve stem without the use of any pulleys.



	On Diagram		Per Cent. Stroke	
	Head	Crank	Head	Crank
Lead	.28″	.39″	......	......
Pre-admission	.01″	.015″	.03	.045
Cutoff	2.865″	2.77″	85.4	82.57
Release	3.2″	3.17″	95 39	94.49
Compression	.185″	.155″	5.5	4.62
Maximum port opening	1.74″	1.845″	......	......

Valve travel = 5.585″.
Stroke = 3.355″ on diagram.

SAMPLE DIAGRAM FROM VALVE ELLIPSE INDICATOR—WALSCHAERT VALVE GEAR.

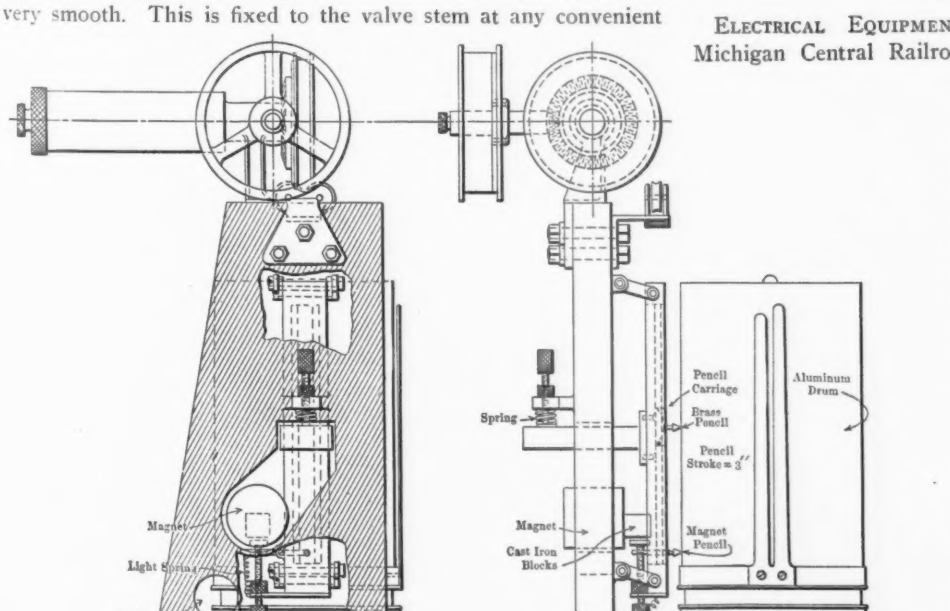


TWO VIEWS OF THE BALDWIN VALVE ELLIPSE INDICATOR.

It is allowable to have the reducing motion actuated by the cross-head run all the time the engine runs, but provision must be made to disconnect the drum from the valve stem so that new paper may be applied.

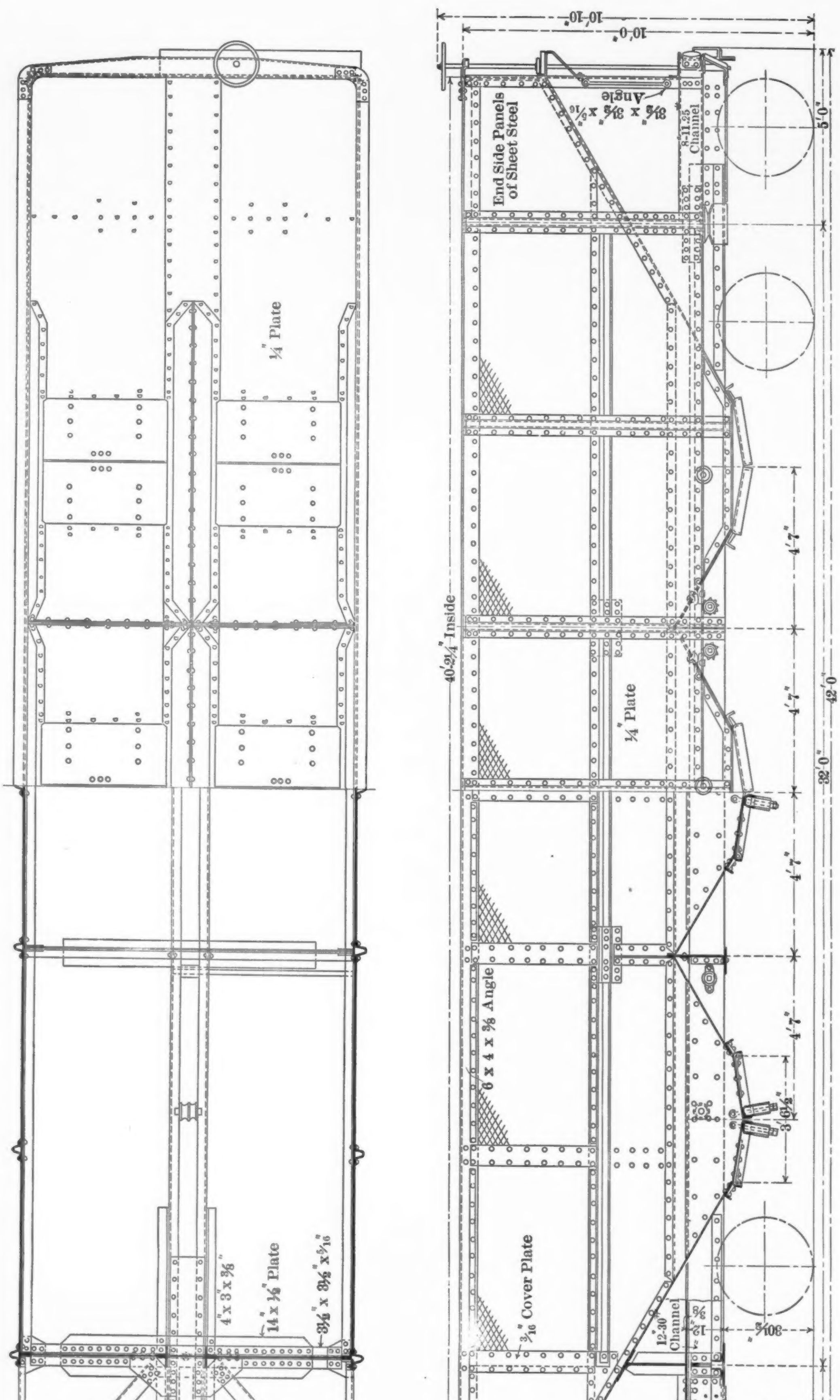
The electrical connections for moving the lower pencil which locates the port lines on the diagram, are made in such a way that in one circuit are contained, 1st, the two terminals on the valve ellipse indicator; 2nd, a primary battery of about 7 volts; 3rd, the contact points, one of which is fixed while the other moves with the valve stem. The contact attached to the valve stem is made in the form of a quadrant half of steel and half of non-conducting fibre set together so that the curved surface is very smooth. This is fixed to the valve stem at any convenient point and then insulated from it, the chord of the arc being parallel to the axis of the valve stem.

The contact point which is fixed to the steam chest or guides is a steel point which is set to rub over the quadrant on the valve stem. It has a spring above it to insure plenty of lift over the arc and is set in a cross-head with adjusting screws so that it may be located directly on the line between the steel and non-conducting parts of the quadrant when the valve is just closing one of the steam ports. The valve can be set in the proper position with a regular valve tram by the port marks on the valve stem.



DETAILS OF VALVE ELLIPSE INDICATOR.

ELECTRICAL EQUIPMENT IN DETROIT RIVER TUNNEL.—The Michigan Central Railroad is constructing a tunnel under the Detroit River between Detroit and Windsor, Can., through which all passenger and freight trains will pass. The trains will be operated through this tunnel by electric locomotives, the electrified zone being 4.6 miles in length. Six 100-ton direct-current locomotives of the swivel truck type, with geared motors, will comprise the initial equipment, each locomotive being capable of handling a 900-ton train up a 2 per cent. grade at a speed of 10 miles per hour. Four 280 horse-power motors will be mounted on each locomotive, and the Sprague-General Electric multiple unit control system will be employed for operating the locomotives together if desired. Current will be taken from the third rail, the power being purchased from the Detroit Edison Company, a pressure of 650 volts being used. A very complete electric lighting and pumping equipment will form part of the project. The electric equipment throughout is being furnished by the General Electric Company.



PLAN, ELEVATION AND SECTIONS OF TRIPLE HOPPER STEEL COKE CAR—PITTSBURG AND LAKE ERIE RAILROAD.

TRIPLE HOPPER STEEL COKE CAR—PITTSBURG AND LAKE ERIE RAILROAD.

STEEL, TRIPLE HOPPER BOTTOM, SELF-CLEARING COKE CAR.

PITTSBURGH AND LAKE ERIE RAILROAD.

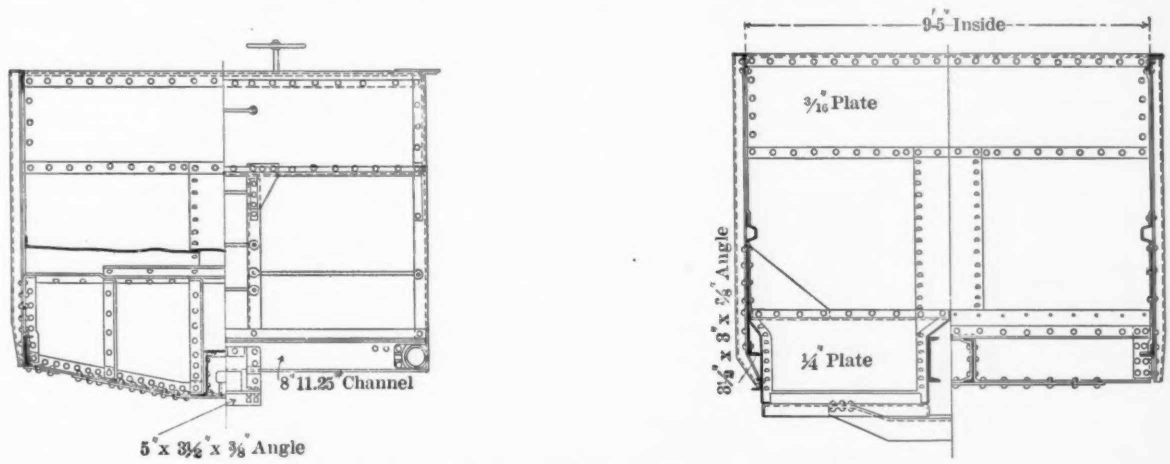
The Pittsburgh & Lake Erie Railroad has recently received, from the Standard Steel Car Company, 1,000 all-steel, 80,000-lb. capacity, coke cars, which are the first 40-ft. coke cars to be built that are entirely self-clearing and are also the first steel cars with triple hoppers, if we except the "three-pot" hoppers with iron bodies and wooden underframes, which were used extensively on the Baltimore & Ohio Railroad for several years, as noted on page 160 of our May issue. The general design of these cars was worked up by Mr. L. H. Turner, superintendent of motive power, and Mr. W. P. Richardson, mechanical engineer, under the direction of Col. J. M. Schoonmaker, vice-president and general manager of the road. The Standard Steel Car Company adapted their detail designs to this general design. One thousand more of these cars have been ordered with the sides 6 in. higher.

The cars have a capacity of 2,406 cu. ft., level full, or 2,580 cu. ft. with a heap one foot high at the center. They are designed to carry a maximum lading of 88,000 lbs., which may be loaded directly over the hoppers, thus adapting them for carrying such material as ore, billets, etc., on the return trips. The general dimensions of these cars are as follows:

Length over striking plates	42′ 0″
Length inside	40′ 2¼″
Width over side stakes	10′ 0″
Width inside	9′ 5″
Height from top of rail to top of side	10′ 0″
Height from top of rail to top of brake mast	10′ 10″
Height from top of rail to top of center channels at bolster	3′ 6½″
Height from top of rail to bottom of center channels at bolster	2′ 6½″
Height from top of rail to center of drawbar	2′ 10½″
Length of door openings	3′ 5½″
Width of door openings	3′ 6½″
Distance from center to center of trucks	32′ 0″
Truck, wheel base	5′ 6″
Truck, journals	5″ × 9″
Weight	40,800 lbs.

The center sills are 12-in., 30-lb., channels. They are placed with their flanges facing inward and extend through and beyond the body bolster about 20 in. Draft sills of 7/16-in. steel, pressed in a Z-shape form, 12¾ in. deep, are spliced to them, as shown. Each center sill is reinforced by a 4 x 3 x ⅜-in. angle, riveted at the bottom on the outside and extending from near the hopper sheet, through the bolster, to the end of the center sill channel. The center sills are also reinforced at the body bolster by a ⅜-in. top cover plate.

The lower half of each side of the car between the bolsters consists of a ¼-in. plate with the upper edge pressed to the shape shown on the drawing, to add to its stiffness, and with a 3½ x 3 x ⅜-in. angle riveted at the lower edge. This side girder is tied to the center sills between the bolsters by the hopper construction and also by the cross ties between the hoppers. These latter consist of a pressed steel diaphragm between the two center sills and a vertical plate flanged at the lower edge, which extends between the center sills and the side girders. The upper part of this plate extends the full width of the car and is reinforced by a light angle which is riveted to it, and by the upper edges of the hopper sheets. A bottom cover plate, forming part of the cross-tie, extends the greater part of the width of the car. An 8-in., 11¼-lb., channel extends from the body bolster to the end sill, forming a side sill extension.



CROSS SECTIONS OF TRIPLE HOPPER COKE CAR—PITTSBURG AND LAKE ERIE RAILROAD.

The body bolster is a ¼-in. vertical plate cut out at the center to fit over the center sills. This plate is flanged at its upper edge to conform to the slope of the hopper sheet and is riveted to this sheet, which is reinforced by a ¼-in. plate, as shown. The bolster plate is reinforced by 3½ x 3½ x 5/16-in. pressed angles placed vertically, and also by similar angles riveted on each side along the lower edge. Two pressed steel diaphragms, placed back to back, are placed between the center sills and riveted to them. A bolster tie plate, ½ in. thick and 14 in. wide,

extends across the bottom of the bolster for nearly the width of the car.

The end sill is an 8-in., 11¼-lb., channel, reinforced at its upper edge by a plate which is flanged at its rear edge and riveted to the uprights, or posts, at the end of the car. The end sill is reinforced at the center by a cast steel coupler striking plate. The coupler carry iron is a 5 x 3½ x ⅜-in. angle iron. Piper friction draft gear is used with a 5 x 1-in. draw bar yoke.

The side and hopper sheets are ¼ in. thick. The vertical sheet at the end of the car is 3/16 in. thick and is reinforced at its upper edge by a ½-in. plate pressed as shown. The top of the side of the car is a 6 x 4 x ⅜-in. angle. The end side panels of the car are of sheet steel. The other panels between the side sheet and the top angle are of expanded metal, No. 6 gauge, 3-in. mesh.

There are two sets of drop doors over each hopper, which are operated in unison by the simple type of drop door mechanism shown on the drawing. The doors for the different hoppers are operated independently. The cars are equipped with Hartman ball bearing center plates and side bearings, the center plates being of drop forged steel and the side bearings of malleable iron.

The trucks have the Andrews cast steel side frames and are equipped with Simplex bolsters.

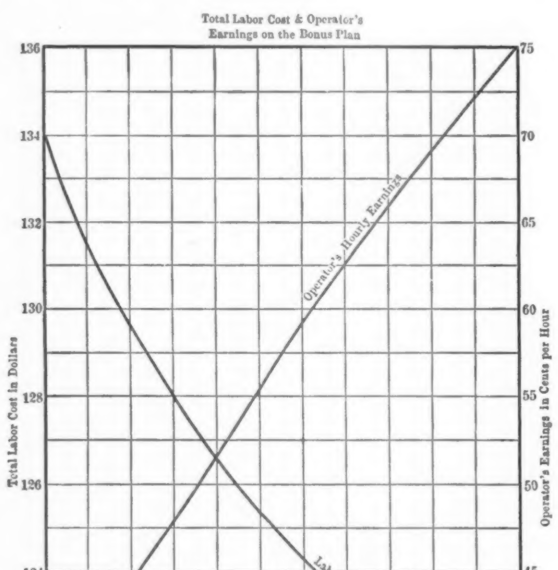
H. J. DOE'S WAGES

To the Editor:

I do not wish to clog the columns of your paper with an unprofitable discussion, but "Individual Effort" (page 287, July issue) did not make clear the point that I tried to bring out in "What's the Use?"

I saw the bonus of \$46.34, also the amount of wages \$79.22, and inasmuch as Doe's creditors would hardly place a premium on a bonus dollar, I added the amounts together, supposing that total earnings was the real key to the situation.

The accompanying curve shows the relation existing between per cent. efficiency and total earnings, total earnings being based



on 322.6 standard hours at a rate of \$3.40, other data for the calculations being taken from page 223, June number.

Suppose we consider that H. J. Doe has a task assigned to him, that, by the company's estimate, is worth 322.6 standard hours; suppose that he performs the task with an efficiency of 90 per cent., which will hold the job for 358.5 hours, and will cost the company \$133.97. Then suppose that he works with an efficiency of 200 per cent., he will hold the job out only 161.3 hours, it will cost the company only \$120.65, a saving to the company of 197.2 hours, and a further saving, due to reduced wages paid to Doe, of \$13.32. As the average month has 260 working hours, Doe could, of course, work the remaining 98.7 hours with a probable efficiency of 200 per cent., thereby raising his wages to a very high figure, but why should he be fined \$13.32 for raising his efficiency from 90 per cent. to 200 per cent. on a given amount of work?

Marvin Ellis.

Youngstown, Ohio.

To the Editor:

Referring to the above communication from Marvin Ellis, I judge from it that:

(1) Marvin Ellis does not like the contract.

(2) He does not consider it equitable.

This divides the question into two parts, which we will consider separately. The first is a case of individual taste and not of individual effort, and as far as tastes are concerned everybody has a right to his own.

The contract Mr. Ellis does not like is:

(1) The operator is guaranteed day pay even if he is not occupied and turns out no work.

(2) Assuming his monthly wages to be \$100 for the time he worked on standard jobs, he is given for making or passing 100 per cent. efficiency a bonus of \$20.

(3) If he passes 100 per cent. efficiency he is paid in addition at his hourly rate for all the time he saves. If his hourly rate is \$0.40, standard time 20 hours, and the work is done in 10 hours, which is an efficiency of 200 per cent., he receives:

(a)	\$0.40 an hour for 10 hours..............	\$4.00
(b)	20% as a bonus on above amount......	.80
(c)	\$0.40 an hour for the 10 hrs. saved.....	4.00
	Total earnings for day of 10 hrs........	\$8.80

It is Mr. Ellis's privilege not to like this contract. I also have dislikes. I dislike to see an ambitious, willing, skilful man urged by a driving foreman to 200 per cent. efficiency and then get nothing but day rate for his reward.

I dislike to see a man on piece rate make tremendous effort and lose out because his machine is out of shape, his belts poor, his tools inferior. I dislike the Halsey plan which sets a standard and then gives the unusually efficient worker from one-third to one-half of the saving in his own time.

Compared to these methods the Individual Effort Contract stands out as altruistic and philanthropic.

Mr. Ellis claims that the contract is inequitable. He bases his claim on the fact that if a man works at 200 per cent. efficiency his earnings are not twice what they are at 100 per cent. efficiency.

Ought they to be? Mr. Ellis says yes. I say no.

Twin brothers are working equally at 100 per cent. efficiency on the same machine, one 10 hours on the day shift, the other 10 hours on the night shift. The day man comes to the boss and says: "My brother wants to lay off. I will double my efficiency to 200 per cent. and do all his work in addition to my own in 10 hours. Give me his wages in addition to my own." The boss replies: "Not if I know it. I have now two good reliable men of 100 efficiency who can work year in and year out at this rate without damage to self or to the equipment. If one is absent the other can temporarily take an overload of 50 per cent. for a day, even of 20 per cent for a week, so that I am only partly and temporarily incapacitated by the absence of the other. You propose permanently to overload 100 per cent., to break yourself down, nervously and physically, to leave me without anyone when you collapse. You propose to rack the machine to pieces and wear out the tools, you propose in part to disorganize the shop by your unreasonable pace, just as a man attempting to run in a crowded street where everybody else is walking, jostles all and causes in the aggregate more delay than he saves on himself. We do not wish to check reasonable ardor, but we shall charge a little

something for the damage and extra cost you are putting us to. You know perfectly well that a boat requires eight times as much power to go twice as fast, and our aim is not to have some men going twice as fast but to bring up all the shop to high efficiency. We tolerate 60 per cent. men and we tolerate 200 per cent. men, but we disapprove of both."

INDIVIDUAL EFFORT.

To THE EDITOR:

Marvin Ellis and "Individual Effort" in your July issue are mighty worried over the theory of my pay check, and the former gentleman's article at first caused me to worry a good deal. It certainly did seem from his figures as if my wife and children were out $1.09 worth of theatre and silk dresses every time I humped myself over 129 per cent. efficiency. Now it took us two months and lots of suspicious questions to get next to the Individual Effort pamphlet foisted upon us, but we finally did think we knew it all, and were satisfied until Mr. Ellis apparently discovered how the company is doing us after all, in spite of the $132.41 extra earnings I made in four months.

My wife hasn't been to high school for nothing, however, and she also strongly disapproved of my going back to straight day work, on account of that one hundred and thirty dollars. So we went all over it again, and we now look at it this way:

A farmer, in figuring his gain at the end of the year, deducts his keep; I guess the president of this road doesn't reckon his salary as part of the company's profits either. Now we claim, in the same way, that the money that really appeals to us is the money we don't have to give away.

When I worked by the day, I used to average $80 a month, but $75 of that amount was gone after twenty-four hours in paying our bills, including $5 we put in the bank. It was the extra five-dollar bill that would cheer us up, and that we'd blow in.

COMPARATIVE EARNINGS FOR TWO MONTHS.
Total Standard Time for all Bonused Jobs being 322.6 hours, and Standard Rate $3.40.

Efficiency.	Time Work'g on Bonus.	Wages while on Bonus.	Bonus per cent.	Bonus Am'nt.	Total Earnings.	Same, less Living Expns.	Comparative Perc'nt'g's.
65%	470.0	$159 80	....	....	$159.80	$9.80	100.0%
80%	403.2	137.09	3.27%	$4.48	164.28	14.28	145.7%
90%	358.4	121.86	9.91%	12.08	171.88	21.88	221.6%
100%	322.6	109.69	20.00%	21.94	181.74	31.74	323.9%
110%	293.3	99.72	30.00%	29.92	189.72	39.72	405.3%
120%	268.8	91.39	40.00%	36.56	196.36	46.36	473.1%
150%	215.1	73.13	70.00%	51.19	210.99	60.99	622.3%
200%	161.3	54.84	120.00%	65.51	215.61	75.61	771.5%

In the above table, based on figures on page 223 of your June issue, my wife shows (and I hope she's right) how much money we have *left over* at the end of every two months, for a certain number of efficiency figures on my part.

With the schedules as now given out to the shop, any man should get up to 90 per cent efficiency and have time to spare. Supposing he does, for every dollar he could get enjoyment out of when he worked by the day, he now has $2.22.

If he cuts out his waste time, and gets down to business, I know he can reach 110 per cent. efficiency, month in and month out, without hurting himself; and he then has over four times as much money to spend on luxuries as he had before.

My wife figures that I have $66.20 every two months, or $33.10 every month to buy her new hats with, while I used to have barely $5 left over.

I cannot deny Mr. Ellis's figures. But, were he in my shoes, I think that after wasting two or three hours in covering several sheets with figures, he'd look at his bank account increasing at an unusual rate, and say: "What's the use?"

Topeka, Kansas. H. J. DOE.

FOUR CYLINDER SIMPLE LOCOMOTIVE.

To THE EDITOR:

The very fine four-cylinder, balanced, non-compound, Atlantic type express locomotive of the Great Western Railway (England), which was illustrated and described in the AMERICAN ENGINEER AND RAILROAD JOURNAL for February last, pages 56-59, has been run upon the testing plant at the Swindon Works of the company, and *The Engineer* (London), in its impression of July 5, contains the following interesting remarks relative to the performance of this engine: "The highest speed attainable was 67½ miles an hour. Beyond this the air-compressing brake *could not absorb the power*. The steady running of this type of engine, as compared with the ordinary two-cylinder engine, is quite remarkable. At 60 miles an hour, the hand placed on the front buffer beam *felt little more than a tremor*. With two cylinders, at that speed, the lateral oscillation on the bogie is quite violent." The italics are mine.

EDWARD L. COSTER,
Assoc. Am. Soc. M. E.

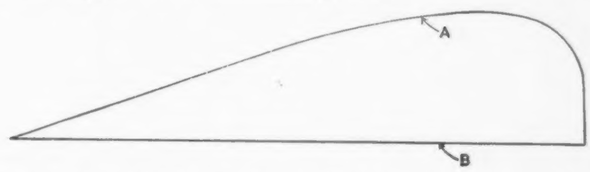
25 Broad Street, New York.

LENGTH OF A CURVED LINE.

To THE EDITOR:

Did you ever try to get the length of a line bounding an irregular figure with the planimeter where more accurate results were desired than by spacing off with dividers?

It is accomplished thus: Take the reading of the instrument in square feet or inches, as the case may be, and extract the square root, which will give the length of one side of a square of equal area and this multiplied by 4, the number of sides, will give the length of the surrounding line.



Take a figure as shown above. The length of "a" can be obtained by subtracting the length of "b" from the result as obtained above. W. O. MOODY.

Mech. Eng. I. C. R. R., Chicago.

FIRST AMERICAN TURBINE STEAMSHIP.—It has been erroneously stated by a number of the railroad papers that the "Creole," which is now being operated in the New York, New Orleans service of the Southern Pacific Company, was the first large turbine steamship of American manufacture to be commissioned. As a matter of fact the "Governor Cob" of the Eastern Steamship Company of Boston, which was launched on April 21, 1906, and went into commission in October of the same year, was the first large ship of this type to be built in America. This ship has a length of 290 ft. on the water line, a width of 51 ft., a draft of 14 ft. and a tonnage of 2,184. It is equipped with Parsons turbines of 5,000 h.p. and is driven through three shafts. The next large ship of this type to be commissioned was the "Yale" of the Metropolitan Steamship Company's fleet, which was launched on December 1, 1906, and placed in commission June 27, 1907. This vessel measures 407 feet over all, has a 63 ft. beam and draws 16 ft. of water. It also has three turbines, giving a total of 10,000 h.p. The turbines in both of these cases being arranged with the high pressure in the center driving one shaft and two low pressure and reversing turbines driving the two other shafts. The "Creole" is thus apparently the third ship of this type instead of the first. It measures 440 ft. over all with a 57 ft. beam and displaces over 10,000 tons. The turbines for the "Governor Cob" and the "Yale," and also for the "Harvard," a sister ship to the "Yale," are of the Parsons type and were built by the W. & A. Fletcher Co. of Hoboken, N. J.

SAFE FERRY SERVICE.—It is estimated that during the 40 years of regular ferry service across San Francisco Bay that 300,000,000 passengers have been carried. During this time but three lives have been lost. The monthly average of passengers now being carried is above the 2 million mark.

About 600,000 persons are dependent on the Pennsylvania Railroad lines for a livelihood.

(Established 1832).

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BY

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to Motive Power Department problems, including the design, construction, maintenance and operation of rolling stock, also of shops and roundhouses and their equipment are desired. Also early notices of owcial changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.*

CONTENTS

The number of engine failures reported as due to "poor coal" and "boiler foaming" with attendant "leaky boiler" will be found on many roads to be a pretty large percentage of the total number. In many cases the excuse of "poor coal" will come from but one or two crews on a division and the indications are that the real trouble is "poor fireman." Also the boiler foaming explanation will be given where nothing but treated water is being used and the probable trouble is careless handling of injectors and throttle. However, as cases have been known where there was one car of a very poor coal in a large supply of generally excellent fuel and water treating plants have been known to suddenly go wrong for short periods, it would not do to designate the engineman by that short and ugly word without more positive proof.

It is to meet such conditions and put accurate information, on which just action can be taken, in the hands of the divisional superintendents of motive power, that a movement is being started of equipping some of the larger divisional points with what is locally known as a "chemical laboratory." This consists simply of a coal calorimeter and a few simple reagents and equipment for water testing. Orders are issued that all reports of engine failures due to poor coal shall be accompanied by a fair sample of the fuel which can be quickly tested and the proper action immediately taken to correct the trouble, wherever it may be. Samples of the water supply are also obtained from stations out of which foaming boilers are reported. Where water softening plants are in general use a daily sample may be advisable during certain periods of the year when the quality of the raw water may fluctuate widely.

Such an equipment does not require an expert cnemist nor the whole time of any employee, and it is easy to see how it could prove to be an excellent investment at points where these troubles were frequent.

Consider for a moment the most successful foreman, official or even president you know. The one whom the men all admire and for whom they gladly work overtime or give up a long planned outing to help out of a tight fix. The one whose men are working for the road and are proud of it. You know such a man; we all do; luckily they are not so very scarce. What kind of a man is he? Does he have a grouch three days a week? Does he overlook the wiper's "good morning"? Does he send out word that he is too busy to see you when you call at headquarters? Are the men afraid to ask him for a small favor? Does he have any difficulty in getting apprentice boys? No? Why not?

Think it over; possibly the secret is not so very deep.

In his paper "Causes of Leaks in Locomotive Boiler Tubes," presented at the last M. M. convention, an abstract of which appears on page 315 of this issue, Mr. M. E. Wells, who has made this subject a special study for a number of years and who is undoubtedly in a position to speak authoritatively upon it, states that the generally accepted idea of cold air entering through the fire-box door being principally responsible for leaky flues is erroneous and that the real source of the trouble is in the ejection of cold water, causing unequal variation of temperature at different times in different parts of the boiler. This, together with the deposits of incrustation, are stated to be the two great causes of all boiler leakage.

The experiments made a number of years ago on the Chicago, Burlington & Quincy Railway and the improvement which has been obtained on that and other roads along lines indicated by the results of those experiments show that Mr. Wells's point is well taken. While, of course, he recognizes the value of the rules governing pumping and of devices for thorough mixing of the entering feed, still these are not the remedies which he suggests. The trouble is in the introduction of comparatively cold water into the boiler and the logical correction of such a difficulty is to heat the water before putting it in, and that is what is recommended in this paper. A feed water heater does not necessarily have to be a complicated device and while it may require the use of pumps in place of an injector it would appear that the very probable results would be well worth the effort.

In tests of any kind the most important feature is accuracy and this has been made the keynote in the design and construction of the dynamometer car, recently completed by the Pennsylvania Railroad, an extended description of which is given on page 293 of this issue. No expense or trouble has been spared in making this car the finest of its kind and delicate refinements of adjustment and construction, which are usually associated only with high class physical and chemical labora-

tories and have heretofore been considered unnecessary for tests of such powerful machines as locomotives, have been introduced in this car.

The possession of this excellent instrument for the testing of locomotives in actual service, taken in connection with the locomotive testing plant for testing under controllable conditions, gives this company a most exceptional equipment, and an opportunity for studying locomotive design such as has never before been available.

AMERICAN SOCIETY FOR TESTING MATERIALS.

The tenth annual meeting of the American Society for Testing Materials was held in Atlantic City, June 20th to 22nd. The attendance was the largest in the history of the society, there being 268 members and guests present. The total membership in the society is now 925 as compared with 835 last year.

The program for the three days' meeting included 61 separate subjects, and two sessions were held each day. Even under these circumstances it was practically impossible to cover the work outlined and it was necessary to read many of the papers by title only and to dispense with discussion. Even when the society is divided into two sections, each holding its sessions at the same time in different meeting rooms, it is easily evident that three days is not sufficient for the work of the association and it is probable that next year four or five days will be allotted.

Probably the most important work accomplished at this meeting was the acceptance of a report of the committee on standard specifications for steel rails and the decision to submit it to letter ballot.

The paper which probably attracted the most attention was one on the subject of "Corrosion of Iron," by Allerton S. Cushman, Assistant Director, Office of Public Roads, Department of Agriculture, Washington, D. C. Detailed experiments of great value, bearing on the theory that rusting is a product of electrolytic action, were reported. This paper was thoroughly illustrated by lantern slides.

Among the many other interesting reports and papers might be mentioned one by Mr. S. S. Voorhees, which gave an account of the practice of the U. S. government in purchasing coal by specifications. These specifications are based on a definite number of British thermal units for one cent and it has been possible to obtain in egg coal 50,000 B. T. U.'s; in furnace coal 53,000 B. T. U.'s, and in pea coal 64,600 B. T. U.'s for one cent. A number of cases were cited where bituminous coal has also been purchased according to similar specifications. The paper by Mr. Robert Job on the "Causes of Failure of Cast Iron in Service" was of much interest and value. It dealt quite largely with the selection of the proper grade of pig iron and the use of ferro-manganese in making locomotive castings.

The address by the president, Dr. C. B. Dudley, upon the subject of "Enforcement of Specifications" was a most valuable and interesting treatment of this difficult subject. He laid special emphasis upon the great importance of the railroads using special care to exclude defective material, especially where it might affect the safety of transportation or the lives of passengers. Dr. Dudley drew special attention to the fact that producers and dealers in railway supplies with practically no exceptions, preferred to do an honest business at a fair price and would always do so if it were not for certain conditions. Among these conditions he mentioned badly worded specifications, whose meaning was not perfectly clear, also unreasonable requirements in specifications. Again the mistakes of subordinates are frequent causes of trouble, an instance mentioned being where five barrels of an inferior grade of oil were included in an order of 50 barrels by a foreman who had only 45 barrels of the proper grade at hand. Some other similar affecting conditions were also mentioned. The whole address is full of good advice on the proper procedure in testing materials and the course to be taken in those found to be defective.

The meeting as a whole was the most successful in the history of the society.

CONVENTION OF THE MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.

The thirty-eighth annual convention of this association will be held in St. Paul, Minn., September 10 to 13. The Hotel Ryan has been selected as headquarters and low rates, which can be obtained by addressing the secretary, have been secured. Since several other organizations are scheduled to meet in St. Paul at this same time it is advisable for all who desire to locate at headquarters to secure their accommodation at the earliest possible date. The subjects to be discussed at the convention are as follows:

The painting of steel passenger equipment. (a) How should the interior be treated? (b) How should the exterior be treated? A composite paper by John D. Wright, H. M. Butts and R. J. Kelly.

Plainness, problems, perplexities and prophecies, pertaining to the present day railway paint shop. Individual paper by Chas. E. Copp.

Disinfecting passenger cars at terminals. What is the most improved method of disinfecting passenger equipment at terminals to comply with state laws? H. E. Smith, R. W. Mahon, and A. J. Bruning.

The cleaning, coloring and lacquering of metal trimmings, lamps, etc., for passenger equipment cars. B. E. Miller, Geo. Warlick and Chas. A. Cook.

Painting locomotives and tenders. (a) What parts should be varnished? (b) What parts can be treated with enamels to advantage? (c) Is it advisable to use asphaltum or oil paints? John H. Kahler, W. A. Buchanan, and Eugene Daly.

To what extent may the various linseed oil substitutes and drying oils be used in the painting of cars and locomotives? W. O. Quest and W. H. Smith.

Queries.—Have you found any material or coating that will resist the action of rust? Discussion to be opened by Chas. E. Becker.

Denatured alcohol. Is it a satisfactory substitute for pure grain alcohol for railroad painters' use? Discussion to be opened by W. J. Orr.

Is it advisable to apply three coats of body color to a car, if two coats will cover? Discussion to be opened by John Gearhart.

Can the lasting qualities of light colored freight car stencil paints be improved? Discussion to be opened by Warner Bailey.

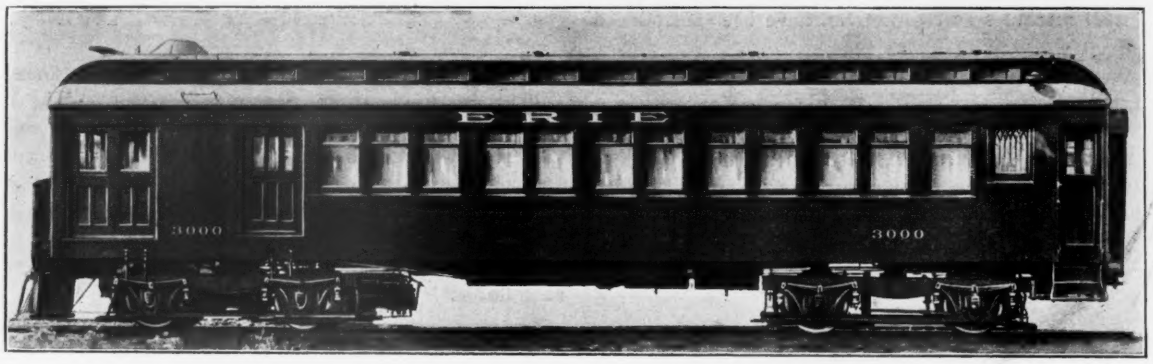
From a painter's standpoint is pressed fibre as durable as a three-ply wood veneer head-lining for passenger equipment? Discussion to be opened by O. P. Wilkins.

What should be the nature of a detergent for railway paint shop use? Discussion to be opened by B. E. Miller.

Mr. A. P. Dane, Reading, Mass., is secretary of the association and should be addressed for all information concerning the convention.

CONVENTION OF THE INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.

The fifteenth convention of the above association will be held in Montreal, Canada, August 20 to 22. The Bath Hotel has been selected as the headquarters and a rate of $2.50 per day for each person has been secured. The subjects which will be discussed at this meeting, together with the chairman of the committees, are as follows: "Flue welding," John Conners. "Tools and formers for bulldozers and steam hammers," G. M. Stewart. "Piece work," Grant Bollinger. "Discipline and classification of work," S. Uren. "Case hardening methods, time taken and samples," Geo. Masser. "Best fuel for use in smith shop," Jos. Jordan. "Frame making, either steel or iron; also repairing frames," Grant Bollinger. "Thermit welding," Geo. Kelly. "What can each member do to increase the usefulness of the association," G. F. Hinkens.



120 HORSE-POWER GANZ STEAM MOTOR CAR—ERIE RAILROAD.

GANZ STEAM MOTOR CAR.

ERIE RAILROAD.

The Erie Railroad during the past few weeks has had in operation on one of its suburban lines near New York a Ganz steam motor car, which is shown in the accompanying illustrations. This is the first car of this type to be constructed in this country and was built at Dayton, O., by the Railway Auto Car Company of New York, which company controls the Ganz patents on this continent.

In brief, the car consists of two compound enclosed steam motors of 60 h.p. each, which are mounted on the forward truck and drive the axles through gearing. In the forward end of the car above the truck is a steam generator which furnishes superheated steam at 270 lbs. pressure for the motors.

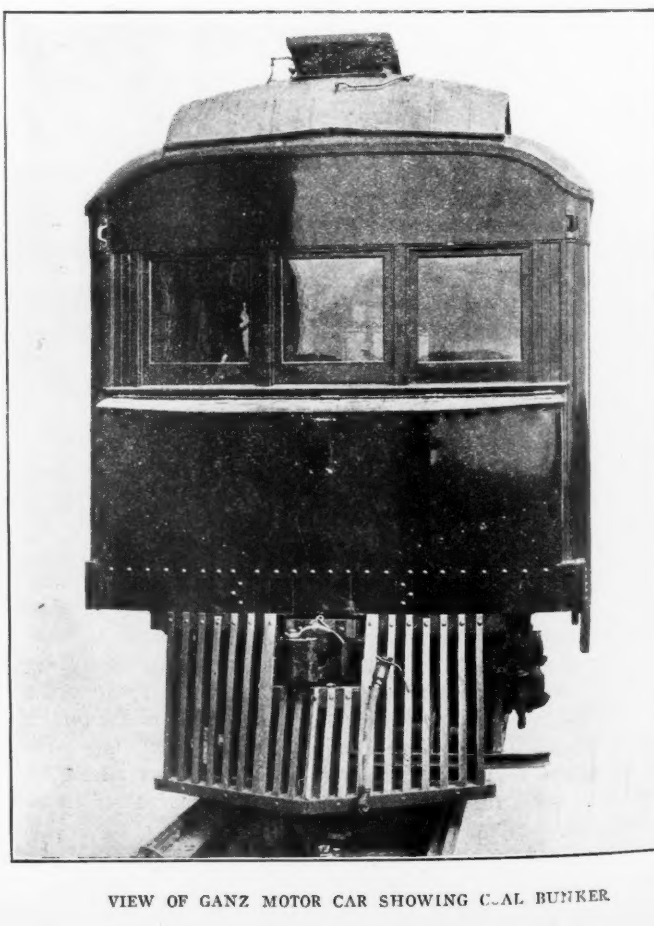
The car body is of wooden construction and in exterior appearance is very similar to a composite passenger and baggage suburban car. It measures 58 ft. over all and seats 50 passengers. The compartment at the forward end is 6 ft. long and contains the steam generator with its accompanying pumps and also the control apparatus for the motors, engineer's brake valve, etc. The fuel, which is either anthracite coal or coke, is carried in a bunker in the forward end of the car projecting out beyond the car body and arranged to be filled from the outside. This bunker will hold enough coal for a continuous run of 50 miles. Just back of the generator room is a 6 ft. compartment for baggage, behind which is a smoking compartment to seat 12 passengers. The remainder of the car is a general passenger compartment. This car weighs 45 tons in working order. It will be remembered that the car which is being built by this company for the Chicago, Rock Island & Pacific Railway (see AMERICAN ENGINEER AND RAILROAD JOURNAL, April, 1907, page 141) weighs but 26 tons and is of approximately the same size. This difference in weight is due to the fact that the Rock Island car is to be of all steel construction, while the Erie car has a wooden body.

The steam motors have cylinders 4.7 and 6.7 x 5.5 in. and are arranged so that either can be operated independently or both work together. The maximum tractive effort is 3,700 lbs. They are completely enclosed in dust proof cases, which are partially filled with oil so that all moving parts receive continuous and thorough lubrication. The cylinders are steam jacketed and the motors are to be operated at a normal speed of 600 r. p. m., although they will run satisfactorily up to 900 r. p. m. A by-pass valve is provided for admitting high pressure steam to the low pressure cylinder to increase the tractive effort at starting or when otherwise necessary. The motors are hung from the frame of the truck by spring suspension, the steam connections to the generator being flexible. Universal joints are fitted to all of the operating rods for controlling the motors. There is an intermediate shaft interposed between the crank shaft and the driving axle which carries three gears, one being in permanent engagement with the gear wheel on the axle, and the other two being fitted with friction clutches. These are of different diameters and can be thrown in one at a time, one combination giving full gear and the other half gear speed.

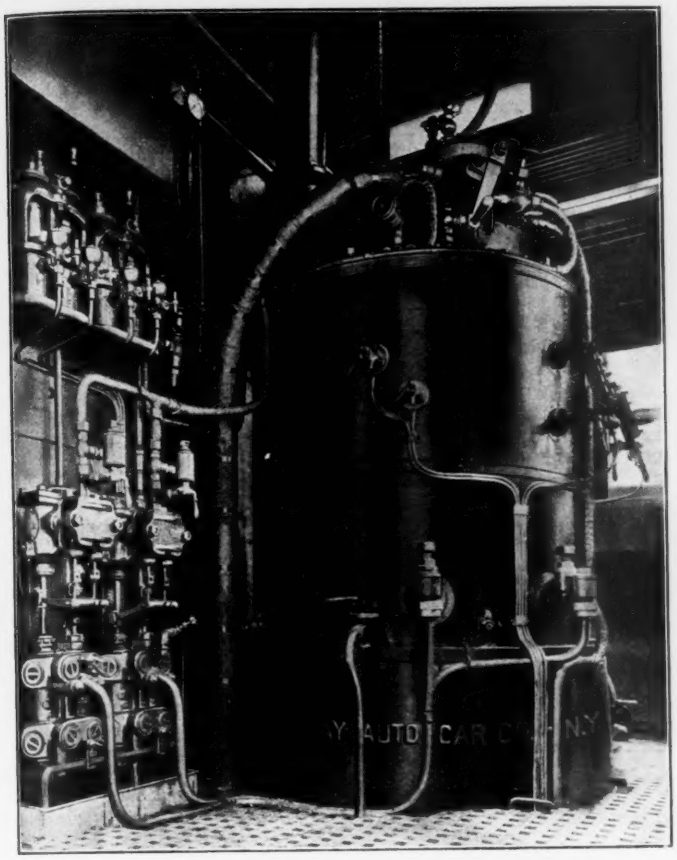
One of the illustrations shows the all steel truck which carries these generators. This truck is specially designed for this purpose and is practically identical with the trucks used on the Ganz cars abroad.

The steam generator is 42 in. in diameter and 5 ft. high. It is of the water tube non-explosive type and consists essentially of four steel cylinders arranged concentrically. The spaces between the two outer cylinders and the two inner ones form the water legs of the boiler and these two spaces are connected by a large number of small tubes which constitute the bulk of the heating surface of the boiler. The water level is below the upper tubes and hence these act as a superheater. The total amount of water in the boiler is comparatively small and a continuous feed is provided from the pumps. This boiler has a heating surface of 212 sq. ft. and a grate area of 6 sq. ft. It is rated at 120 h.p., delivering the superheated steam at 270 lbs. pressure. It is claimed that steam at this pressure can be obtained in from 20 to 30 minutes from cold water, using either coke or anthracite coal.

Provision has been made for easily exposing the tubes for cleaning and the boiler is provided with a patented construction at the mouth of the feed pipe by means of which the feed water assists in cleaning out any mud that clings to the tubes. The water supply is carried in a tank of 600 gal. capacity built in the underframe of the car.



VIEW OF GANZ MOTOR CAR SHOWING C‿AL BUNKER



STEAM GENERATOR—GANZ MOTOR CAR.

The air brakes are of the Westinghouse type, the air compressor being mounted on the trailer truck and driven from one of the axles of the truck. Lighting is by Commercial acetylene gas and the car is heated by steam.

This car is designed for a speed of 40 miles per hour on the level and 15 miles an hour on two per cent. grades and will haul a trailer at a speed of 30 miles per hour on a level track. In a recent trial trip a speed of 45 miles an hour was maintained.

PERSONALS

Mr. S. J. Merrill has been appointed master mechanic of the Union Pacific R. R. at Denver, Colo.

Mr. Albert T. Van Antwerp, master carpenter of the Pennsylvania Railroad at East Aurora, N. Y., died June 16. Age 65 years.

Mr. W. S. Kenyon has been appointed master mechanic of the fourth division of the Denver & Rio Grande R. R., with headquarters at Alamosa, Colo., vice Mr. G. W. Mudd, resigned.

Mr. William Baird has been appointed general car inspector of the Chicago, Burlington & Quincy Lines west of the Missouri River, with headquarters at Lincoln, Neb., vice Mr. E. S. Barstow, resigned.

Mr. W. J. Wilgus, vice-president of the New York Central & Hudson River Railroad, who has been in charge of the electrical installation from its inception, has tendered his resignation to take effect October 1.

Mr. W. O. Thompson, assistant superintendent of motive power of the R., W. & O. division, has been appointed master car builder of the New York Central at East Buffalo, to succeed the late James Macbeth.

Mr. H. C. Manchester, master mechanic of the Boston & Maine R. R. at Mechanicsville, N. Y., has been appointed assistant superintendent of motive power of the Maine Central R. R., with office at Portland, Me.

Mr. D. D. Robertson has been appointed master mechanic of the Lehigh Valley R. R. at Sayre, Pa., succeeding Mr. A. C. Adams, resigned. Mr. Robertson was until recently general master mechanic of the Fort Worth & Denver City Ry.

Mr. W. H. Chambers, assistant master mechanic of the Denver & Rio Grande R. R. at Helper, Utah, has been appointed to the new office of master mechanic of the Denver & Rio Grande R. R., the Rio Grande Western Ry. and the Colorado Midland Ry. Headquarters at Grand Junction, Colo.

Dr. W. F. M. Goss, dean of the school of engineering at Purdue University, has resigned to accept the deanship of the engineering schools of the University of Illinois. Dr. Goss has been at Purdue since 1879, when he organized the department of which he has since been the head. He is a graduate of Massachusetts Institute of Technology.

Mr. James Macbeth, master car builder of the New York Central at East Buffalo, died on July 5 at his home in Buffalo, N. Y. Mr. Macbeth was born in Aberdeen, Scotland, and began railroad life in this country in 1859 as an apprentice in the machine shops of the Great Western Ry. of Canada. He had been in the position he held at the time of his death since 1893. Mr. Macbeth was a charter member of the Central Railway Club.

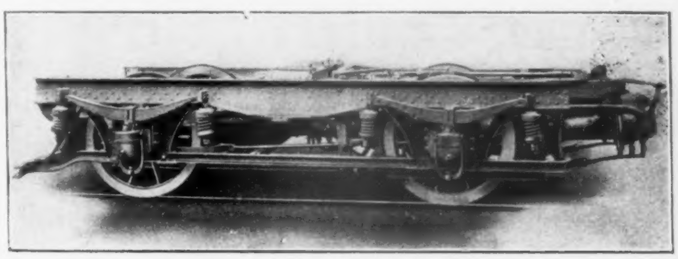
BOOKS

Proceedings of the American Railway Association Meeting, held in Chicago, April 24, 1907. W. F. Allen, secretary and treasurer, 24 Park Place, New York City.

This copy of the proceedings contains a list of the members of the association, together with a list of the members of the many committees of the association. It includes complete reports of all the committees, together with the discussions thereon. An appendix is included, giving a report of the car hire meeting held on November 9, 1906, and the informal conference of owners and users of cars held on April 22, 1907.

Railroad Men's Catechism. By Angus Sinclair. Bound in Cloth. 216 pages. 4¼ x 6½ in. Illustrated. Published by the Angus Sinclair Publishing Company, 136 Liberty Street, New York. Price, $1.00.

This book includes, in catechism form, a large amount of information which will be useful to all classes of railroad men. The questions cover the entire practice of train operating and explain all details of mechanism. The basis of the questions



TRUCK—GANZ STEAM MOTOR CAR.

used in this book are a series prepared for the examination of engineers and firemen employed on one of the leading railway systems. To these have been added many others, including the 20 questions and answers on the standard code of the American Railway Association. A section on mechanical calculations has also been added. The book is illustrated where necessary and will be found to fulfil its purpose in a very satisfactory manner.

FORTY THOUSAND DOLLARS A DAY FOR NEW EQUIPMENT.—According to figures recently compiled in the New York office, the Harriman Lines have been spending an average of $40,000 a day for new equipment during the past five years.

MASTER MECHANICS' ASSOCIATION.

FORTIETH ANNUAL CONVENTION.

ABSTRACTS OF REPORTS AND INDIVIDUAL PAPERS.*

Locomotive Failures, Records, and the Results of Keeping Them.

INDIVIDUAL PAPER BY W. E. DUNHAM, M. M., C. & N.-W. RY.

The failure of an engine in service interests so many of the various departments of a railroad directly or indirectly, as well as the traveling or shipping public, that every effort is bent toward avoiding them. Shortage of power at times may compel the use of engines on the road which, under ordinary circumstances, would be held for repairs. These engines should not be expected to handle full tonnage, but should be favored to a degree determined by the master mechanic in charge. But, on the other hand, no engine should be permitted to start on a trip unless the roundhouse foreman is practically sure that the engine will make the trip successfully if it is handled properly and has to be turned and does not arrive in time to be dispatched and cared for before leaving time.

Second. A delay at a terminal, a meeting point, a junction connection, or to other traffic, or a reduction of tonnage due to an engine breaking down, not steaming well, running hot or any defect in the engine, constitutes an engine failure.

Under these rules the following can, with justice to all concerned, be considered as not constituting engine failures:

1. Delays to passenger trains when they are five minutes or less late at terminals or junction points.
2. Delays to scheduled freight trains when they are twenty minutes or less late at terminals or junction points.
3. Delays to extra dead freight trains if the run is made in less hours than the miles divided by ten.
4. Delays to fast schedule trains when the weather conditions are such that it is impossible to make the time, providing the engine is working and steaming well.
5. Delays when an engine loses time but afterward regains it without delay to connections or other traffic.
6. Delays to a passenger or scheduled freight train due to other causes, and the engine (having a defect) makes up more time than it loses on its own account.
7. Delays when an engine is given an excess of tonnage and stalls on a bill, providing the engine is working and steaming well.
8. Delays when an engine gets out of coal or water caused by being held between coal or water stations an unreasonable length of time.
9. Delays due to engines steaming poorly or flues leaking on runs where the engine has been held on side tracks for reasons other than the defects of engine, or on the road an unreasonable length of time; say fifteen hours or more per one hundred miles.
10. Reasonable delays for cleaning fires and ash pans on the road.
11. Delays caused by breakage of some part of the engine due to sticking obstructions on or beside the track.
12. Delays due to broken draft-rigging on engine or tender caused by air being set on the train on account of burst hose or break-in-two.
13. Delays to an engine coming to the shop for repairs when it is hauling full tonnage.
14. Delays caused by an engine being held in the roundhouse for needed repairs and called for by the operating department, although they have been informed that the engine will not be ready until a stated time.

CHICAGO & NORTH-WESTERN RAILWAY COMPANY.

..................Div. MOTIVE POWER AND MACHINERY DEPT. ....190......

To..................M. M.

Engine No..........*Train No*..........*Date*..........*Departed from*..................

at..........*M. Arrived at*..................*at*..........*M.*

Enginemen will fill out one of these forms for each trip, giving each delay of **THREE** minutes or more from whatever cause, and state the cause of each delay.

PLACE DELAYED	TIME DELAYED	STATE CAUSE OF DELAY AFTER EACH POINT	MADE UP TO STATION	TIME IN MINUTES
Delayed leaving		*Signed,*		
Late arriving		..................*Engineman.*		

ENGINEMAN'S DELAY REPORT.

not delayed unreasonably. Also an engine crew should be given as much consideration as engines. They cannot work continually on short hours of rest unless their working hours are also made short.

It is natural during a rush period, whether of long or short duration, that engine failures should increase in number and often in proportion to the total miles run in a given period of time. Such results, however, may be due more to the operating methods and conditions than to any lack of attention on the part of the roundhouse forces. Under these circumstances the division as a whole should be held responsible, instead of the motive power department alone being charged with a failure.

There exists at the present time on American railways no uniform method of recording engine failures. This is due to several causes, chief among which is the fact that what would be considered an engine failure on one road would not be on another. A complete file of what constitutes engine failures would contain as many definitions, almost, as there are railroads.

A failure is the result of ineffectual efforts to accomplish a desired end. The desires of the railway train service are: to keep all trains moving promptly; to leave the starting terminal on time; to make all meeting points; to make all junction connections; to avoid delays to other trains, and reach the destination on time. A failure should therefore be charged to an engine when through some fault of the roundhouse, the engine or the engine crew, the train fails to meet these expectations. But let us suppose that a delay does occur as the result of a defect in the engine, but at the same time all meeting points and junction connections are made and the train departs and arrives on time. Should a failure be charged? Would not a record of a delay answer all the purposes? An engineman hates to be responsible for a failure, but he takes pride in being able to make up for all delays for which he or his engine are the cause.

Any set of rules for making engine failure records should be lenient, in a measure, to both the mechanical and transportation branches of the operating department. Reasonable leeway should be given on both sides. Experience is the best guide as to how much this leeway should be and experience also is the best guide as to what an engine should be charged with. Considering all parties directly interested a fair statement of what constitutes an engine failure might be as follows:

First. A delay waiting for an engine at an initial terminal constitutes an engine failure, excepting in cases where an engine

Any system of engine failure reports must start with the advice received from the engineman by the dispatcher. This should include sufficient information to show whether the boiler, the machinery or some of the special attachments are troubling, and, if possible, give a brief detail of what is wrong. The dispatcher then should advise the master mechanic, or the division foreman and also the road foreman and the local foreman of the terminal toward which the engine is headed. Upon the arrival of the engine the roundhouse foreman or his representative should make a personal and close examination and prepare a statement, which he forwards to the master mechanic along with the engineman's written explanation. These papers will give the master mechanic full knowledge of the case and they should be in his hands within twenty-four hours after the failure occurs. This prompt action is of particular value in connection with failure reports, convincing all concerned that things are being watched and checked closely.

With a view to having uniformity in their reports and saving time, blank breakage report forms, printed in copying-ink, can be used. These reports should first be checked by the local master mechanic and shop foreman and then passed on to the assistant superintendent of motive power, who in turn sends them to the mechanical engineer for final checking and filing.

* Continued from page 278, July number.

CHICAGO & NORTH-WESTERN RAILWAY COMPANY.

....Division.

Report of Engine Failures, for ten days ending...................................... .. 190......

INSTRUCTIONS.—Three of these reports must be made each month. The first to include all failures from the 1st to 10th, inclusive; the second, 11th to 20th, inclusive; and the third, 21st to and including the last day of the month. They should be forwarded not later than three days after termination of period which they cover. *Actual* cause of failure must be shown.

DATE OF FAILURE		ENGINE NUMBER	TRAIN NUMBER	ENGINEER	TOTAL TIME DELAYED	TIME MADE UP	CAUSE OF FAILURE AND REMARKS

DIVISION REPORT OF ENGINE FAILURES.

Upon the accuracy and detail of these first papers depends the full value of the failure records. As a further check upon the work performed by the engine, a delay report can be made out by the engineman for each trip. An outline of this form is shown. Frequently by following back a few days and noting the performance of the engine as shown by these reports the real cause for the final failure can be found. A good supplementary report in this same connection is one of a similar character made by the conductor to the division superintendent.

After a full examination and investigation of each failure a monthly division report should be made by the master mechanic to the superintendent of motive power. A more frequent report of this kind is often advisable, for instance, once every ten days. These reports can then be compiled in the superintendent's office, a statement being made which classifies and details the failures and also shows totals for each division or terminal of the railway.

Any system of reporting engine failures should have for its sole aim the improvement of the service by giving information as to what is causing trouble. This requires accuracy, as previously mentioned. There is a natural tendency for enginemen to be rather cautious about sending telegraph reports of defects or troubles on snap judgment as well as a similar tendency for a dispatcher to be inclined to blame the engineman or the engine for being the primary cause of a train delay. These active representatives of two branches of the operating department are the men who can do the most toward reducing engine failures by keeping in close touch with each other when on duty and by giving all the facts in a plain and full manner when trouble does occur. If the failure is due to long hours on the road the information is of value to the superintendent, who can determine the necessary action for increasing the speed of the train or trains. From these same records his attention is forcibly brought to the results of inferior coal, poorly designed and operated coaling stations, scanty and bad water supplies, overloading of engines, indifferent train-dispatching, lack of harmony in action on the part of the men in charge of the trains.

To the mechanical department officers these reports are particularly valuable. In connection with the same records made by the shops, they show up poor designs, weak parts, inferior material, bad shop practices, careless handling, indifferent inspection and poor workmanship. The local master mechanic and shop foreman make the first use of these reports as they receive them. Inspection of the broken or defective part, together with the report of what occurred, gives them the best possible line-up as to what is necessary to prevent a repetition. Their investigation should be carried to a finish and the exact cause found.

The full report then goes to the next higher officer, usually the assistant superintendent of motive power. Here it is checked and by the frequency of similar reports, attention is drawn to some particular defect. It may be some type of cylinder head, rod strap, eccentric or any such part of the machinery of a certain class of engine that is giving particular trouble. Or it may be a certain make of boiler will not stand up to the service. These reports quickly show these defects to those who are in charge of such matters. The detail can then be quietly and efficiently remedied without the necessity of any further investigation. Such, generally, is the case if some shop or shops are at all careless in preparing the work or are passing as good enough, parts that are not true to dimensions or shape, or material designated.

When the assistant superintendent of motive power is through with his investigation the reports should go to the mechanical engineer. He should check the dimensions and shape of the broken piece. As the result of his analysis data are obtained for use in future designs either for new parts to take the place of defective ones or for preparing plans for new engines. It shows to him where modern shop practices and road service have found the weak spots in older types of engines. Steps are then taken through the proper channels to discard the troublesome member and substitute as fast as possible a modern design. Concrete examples of instances where such a system of reports has resulted in improvements to the service and cost records would approximate a complete history of nearly all our modern improvements.

There is no doubt as to the merits of such a system of failure reports as outlined, in the minds of those who have followed it carefully and consistently. With our railway systems spread over a large territory and divided up into small sections for operating and mechanical attention, it is absolutely necessary that some general procedure such as this be followed. Also for the purposes of comparison between different lines it is to be hoped that some standard agreement can be reached for recording and classifying engine failures.

Causes of Leaks in Locomotive Boiler Tubes.

INDIVIDUAL PAPER BY M. E. WELLS, A. M. M., WHEELING & LAKE ERIE R. R.

For convenience of discussion, the subject can be divided into two general heads: Leaks due to mechanical causes; Leaks due to variation in temperature.

MECHANICAL CAUSES.

The first can be divided into four subheads—first, defective work at the time of first setting the tubes. This, as a cause of tube leakage, is very slight, because almost any kind of a job done by an apprentice boy in the front end will hold from one shopping of an engine to the next; while a much better job done by a skilled mechanic gives practically no trouble, and really never causes a delay, when done on the upper tubes in the fire-box; and yet the most skilful job that it is possible for a skilled mechanic to do on the bottom tubes in the fire-box will hold, at most, but a few days, in our largest boilers.

The second cause under this head, that of poor hurry-up work in running repairs, is a much more prolific source of trouble than any one of the other mechanical causes, and yet the remedy is quickly stated—take time to do it well.

The third subhead is the possible cause of leaks on account of the vibration of the tubes. Much stress is put upon this by some, especially if long tubes are used. This vibration as a cause of leakage cannot be considered very important, because if it was this action would certainly loosen the very simple job of tube setting done in the smoke-box tube plate.

The fourth mechanical cause is the wearing out of the tube ends by the abrasive action of the cinders. This cause is suggested by the Northern Railway of France, and the same, or a similar condition, is referred to by the Pennsylvania Railroad, as "burnt-off and cracked beads, due to shallow fire-boxes." It will be shown later that the real cause of this condition is internal, rather than external, and that, really, it should be classified under the second general head, namely, leaks due to variations of temperature.

LEAKS DUE TO VARIATION OF TEMPERATURE.

Under this we have two subheads: causes of leaks due to equal variations of temperature, and those due to unequal variations of temperature.

It can be clearly demonstrated that small damage is done to boiler tube joints when they are subjected to equal variations of temperature; that is, tube ends, fitted in a tube plate, can be heated up and cooled down a great number of times, and not become loosened, if all connected parts are heated up and cooled down uniformly. This we have also learned in a practical way from the fact that the top tubes in a fire-box give practically no trouble from leaking, as compared with the bottom tubes, and yet these top tubes are subjected to slightly higher temperatures than the bottom tubes. The best proof of this we find in some tests made by the Chicago Great Western Railroad, and reported in the 1904 Proceedings of this Association. These show, conclusively, a hotter condition of the top tubes than of the bottom tubes. We must therefore conclude that the deterioration and leakage of the bottom tubes in the fire-box does not come from heat alone; the real secret being that we cannot keep the bottom tubes hot enough—or at least uniformly hot—on account of the cooling constantly taking place in the water space, due to the injection of feed water. Another significant fact in this con-

nection is, that the tubes never leak in the front tube sheet. The argument that it is not as hot seems, in the past, to have put an end to this discussion. And while this is so, yet it averages practically one-third as hot—and one case is reported where, on a narrow fire-box boiler with short tubes, the front end temperature ran up to one-half that of the fire-box—if there was really much action on the part of heat alone to loosen these joints, they certainly should be affected by this heat; but they are not loosened, even after months of service. And added to this, you have all seen the front ends of the tubes and the front tube sheet banked solid with scale, and still no leakage. If the bottom tubes in the fire-box leak at regular intervals—and this is, at the best, every four or five days—why should not tubes leak after months of service, subjected to one-third or one-half the temperature of the fire-box? We are, therefore, led to the conclusion that there are causes, other than the equal variations of temperature, that really cause most of the leaks in boiler tubes. This brings us to the last and most important division of our subject, that of leaks due to unequal variations of temperature.

* * * * * * *

I now want to draw your attention from this much-talked-of imaginary cause (cold air) to the two real and important ones, namely, leaks due to deposits of incrustation, and those due to unequal variations of temperature produced by the varying water temperatures, especially those caused by the injection of feed water. These are the two great causes of all boiler leakage, and the two lines along which much improvement is yet possible. A most important line to work along is the improvement of feed water, and yet good judgment must be used to guard against transforming a fairlv good hard water district into an alkali district, that will give you so much foam that you cannot pull cars. The benefits derived from a decrease of incrustation is beyond question; but when we must trade lime for soda there enters one of the most difficult problems that to-day confronts the railroad chemist. How much soda can we afford to take for the advantage of getting rid of a certain amount of incrusting water? The question should be carefully worked out for each operating district as a whole, before anything is done toward spending money for plants. (At this point the author introduces the formulæ of some home-made anti-incrusting compounds that have been in constant use for years past, and are still in use, on Eureopean and other railways. They are taken from the Proceedings of the International Railway Congress.)

* * * * * * *

This brings us to the subject of leaks produced by the unequal variations of temperature in the water space. So much has already been said and published along this line that we will merely refer you again to tests showing the effects of injudiciously injected feed-water as a cause of leaks, as reported in the 1904 Proceedings of this Association (pages 231 to 241) by the Burlington Railroad. There is scarcely a trip made by any of your enginemen but what, in most cases, it is dependent upon the crew as to whether they are delayed or not by leaky tubes. It is so important a factor that they should receive all the education possible along this line.

While the education of enginemen is a most important line to work along, yet I believe the members of this Association should be bending their energies along the line of changing the method of feeding, or using warmer water with which to feed, their locomotive boilers. If the temperature of the water entering boilers could be raised to a temperature corresponding to the maximum steam pressure, or if it could be heated to this same temperature after entering but before being liberated in the boiler proper, our boiler troubles would be wonderfully reduced, even when using average feed-water, because, as I have said before, our trouble is from cold water and not from cold air or burned tube ends and side sheets. I sometimes think that the prevalence of the cold air idea has come from the fact that almost every locomotive boiler ever built has had the fire door on a line with the bottom tubes, and, in shallow fire-boxes, on the line of most of our side sheet troubles; and, for want of better knowledge, we got into the habit of saying it was cold air, and the habit, like all other habits, is hard to change. I have had experience with large locomotives in the West which, on account of burning lignite coal and to reduce spark throwing, had very large arches fitted and cemented perfectly tight against the tube sheet, so that every particle of fire and gases had to come back and go over the top of the arch before reaching the tubes. The bottom tubes in these boilers leaked, just as they do in any other boiler, and yet these bottom tubes were practically as free from the effects of so-called cold air as were the front ends of these same tubes.

The best information received on fire-box and front end temperatures is the following from the Pennsylvania Railroad, in answer to two of the questions sent out:

"When a boiler is being worked the hardest, what do you find the temperature of the fire in the fire-box, or at the back end of the tubes, to be? When burning 130 pounds of coal per square foot of grate, there is a temperature of about 2,300° (see Locomotive Tests and Exhibits, Pennsylvania Railroad, St. Louis, 1904, pages 695 to 699). With an Atlantic type of locomotive on the testing plant, when burning 168 pounds of coal per square foot of grate per hour, a temperature of 2,415° was obtained.

"When a boiler is being worked the hardest, what do you find the temperature in the smoke-box or front end of the tubes to be? For freight locomotives as developed at St. Louis, 574° to 757°. For passenger locomotives tested, 594° to 787°."

The temperature of boiler plates averages about 75° hotter than the water in the boiler. In fact, this is high, because for years soft plugs have been used filled with 450° F. metal; and this is but 62° above the temperature of a boiler carrying two hundred pounds of steam.

Along the line of doing something to overcome the bad effects of injected feed water—and this is what I want, especially, to interest you in—the London & Southwestern Railway of England sends us the most interesting report received: "We have given up the use of injectors. When injectors require renewing they are replaced by duplex pumps for feeding the boiler with hot water, heated by exhaust steam passing through steel tubes in the water tanks. I should think this would be a great advantage to your boilers. Our practice is to start the pumps when we start the train from a terminal station, and keep them constantly at work until stopping. This constant feed prevents any rapid difference in the temperature of the water in the boiler. We pass our feed water through the smoke-box so that when it enters the boiler it is up to the same temperature. We mark the gauge glass giving the maximum and minimum height of water feed; our variation is one-half." This road in another part of its report says: "We have little or no trouble with leaky tubes; and not such as to require attention between trips."

I hope you will get an inspiration from what this English road is doing, and do something along the line of feeding your boilers with warmer water, or at least feed it into the boiler in such a manner that a low temperature water cannot settle and circulate through the back ends of the bottom tubes and around the bottom of the fire-box sheets, thereby causing most of your boiler troubles. If I can impress this Association with the fact that a very large per cent. of their tube and fire-box troubles would be over if they could only stop the destruction that is going on from this one agency alone, I shall feel that this paper has not been in vain.

Mechanical Stokers.

Committee—Wm. Garstang, chairman; D. F. Crawford, J. F. Walsh, G. F. Hodgins.

Since the last convention, trials of the Day-Kincaid, Hayden and Krouse automatic stokers for locomotives have been continued by various railroad companies. The data obtained from these tests are not, as yet, in sufficiently conclusive shape to make it desirable to present them to the Association.

Your committee has advice that one of the larger railroads in the country has prepared designs of two types of experimental stokers, the test of which, it is expected, will be started at an early date.

Development of Motor Cars for Light Passenger Services.

Committee—H. F. Ball, chairman; F. T. Hyndman, W. R. McKeen, Jr., L. R. Johnson, G. W. Wildin.

GASOLINE MOTORS—MECHANICAL TRANSMISSIONS.

Union Pacific.—In this country, the most extensive development work in the rail motor car field has been done by the Union Pacific Railway. To date, that railroad has built nine gasoline motor cars, all of which have direct mechanical drive.

Their latest design of car, motor car No. 8, is equipped with a 200 h.p. motor, especially built for the rough service incident to that of suburban lines. The motor consists of six cylinders, 10 inches diameter by 12 inches stroke. The total weight of the car is 61,300 pounds, equivalent to practically 300 pounds weight per 1 h.p. This car has, since last summer, been running regularly between Beatrice and Lincoln, Nebraska; it has shown remarkably uniform results and has materially increased the traffic between those two towns. Ten additional cars, similar to this successful model, are being built, as well as a number of trailers to be used in connection with them. Four regular branch line services have been maintained in Kansas and Nebraska, on the Union Pacific Railroad alone, during the severe weather conditions of the past winter, and with notable success. The motor cars have been remarkable in regularity of service, having demonstrated that they are even superior, in this respect, to the steam train service.

After two years of continuous service, it has been found that the average cost of fuel the year around, taking into consideration both summer and winter conditions, using 72 degree gasoline, amounts to 3.5 cents per car-mile. As a substitute for gasoline, California distillate has been used in regular service with gratifying results. Obviously, the cost per car-mile is thereby greatly reduced, as the distillate is a much cheaper product than gasoline. Some interesting experiments have been conducted with the motor of car No. 8, using denatured alcohol as fuel.

The results were very satisfactory, in fact the newest type of motor (No. 8) gives equally as good performance with that fuel as with gasoline.

"Sunny Brook."—A light railway motor car, the "Sunny Brook," has recently been built at Indianapolis, Ind., for service in Yellowstone Park. This car has a four-cylinder gasoline motor, cylinders 6 by 6 inches, the engine developing 50 h.p. at 700 r.p.m. The car is built after the conventional street car design and weighs 30,000 pounds.

GASOLINE MOTORS—ELECTRIC TRANSMISSION.

Strang Cars.—Another example of gasoline rail motor cars in successful operation is the Strang car, mentioned in last year's report. Three of these cars are in regular operation between Kansas City and Olathe. The first one has been in continuous service for over a year, the second and third cars having been in operation between six and seven months. Other cars of this type are now under construction for use on several steam roads. The transmission used in the Strang system is of the electric type, the generator being direct connected to the motor, forming a self-contained generating unit. Directly from the brushes of the generator, main wires lead to a controller of the series parallel type. From this controller, wires lead to electric motors hung on the axles of the front trucks according to standard electric railway practice. In multiple with the wires between the generator and controller, is connected a small storage battery, and in one of the main wires between the battery and the generator is placed a rheostat, which is used for the purpose of temporarily converting the generator into a motor when starting the engine. The first of the above-mentioned cars * weighs 78,000 pounds, and it is claimed that the gasoline consumption has averaged about .45 of a gallon of gasoline per motor car-mile for a mileage of 60,000 miles. The largest and latest of the three cars † above mentioned is 52 feet 9 inches long, weighs 84,000 pounds and has the following equipment: 100 h.p. gasoline engine, 50 kw. generator, two 65 h.p. motors and storage battery of 112 cells, with 250 a.h. capacity.

St. Joseph Valley Traction Company.—The motor car used on this road was in actual daily service for two years. Within the past two months, the equipment was destroyed by fire. The service of this car consisted in hauling from one to three trailers, three round trips per day, over a road eleven and one-half miles in length, making the half trip in thirty-five minutes with four stops, the heaviest grade being one and one-half per cent. It is stated that the fuel consumption with one trailer was three-fourths of a gallon per mile.

General Electric Company Car.—This company is now bringing out its second-rail motor car of the gasoline-electric type. The car body is of steel, the ends being rounded to decrease wind resistance. The roof is of the Mann type, equipped with globe suction ventilators. The car body is divided into an engine compartment, baggage, smoking, main and toilet compartments, and operating-cab at rear end. It has a seating capacity of forty.

The equipment consists of an eight-cylinder V construction gasoline motor of 150-175 h.p., direct connected to an eight pole, commutating pole, 90 kw. generator with an exciter of 3½ kw. capacity, for the purpose of exciting the fields of the main generator, and effecting the variable potential control. From the generator leads are conducted to two 65 h.p. motors, situated one upon each truck of the car. These motors are always connected in parallel, the required torque or speed being obtained by varying the field current of the generator through the intermediary of a specially constructed controller, embodying essentially the required resistance suitably arranged in fifteen steps.

The gasoline motor is of the four-cycle type, equipped with two separate systems of ignition. The carbureter is of the single-nozzle hand-compensated type, gasoline being supplied to it by means of a diaphragm pump. Radiators for water cooling are located on the roof of the car. The circulation is by thermo syphon. The gasoline motor is controlled by one lever superimposed over the controller handle. The normal speed of motor is 550 r.p.m. The car is heated by by-passing as much as required of the exhaust gases through pipes approximately in the same position as steam pipes in the standard railway coach. An acceleration of a mile per hour per second is obtained to approximately 25 to 28 miles per hour. From this point, acceleration falls off gradually until full speed is attained at approximately 50 to 55 miles per hour. The total weight of the car is 60,000 pounds.

STEAM MOTORS.

Canadian Pacific.—In the steam motor car field, one of the noteworthy examples of original development work is found in the car designed and built by the Canadian Pacific Railway ‡ This car was in operation all of last summer between Montreal and Vaudreuil, a distance of twenty-four miles, giving a service of three round trips per day, on a regular schedule, allowing one hour for the run out, including twelve stops, and the same on the return trip. It was popular with the passengers and gave fairly good satisfaction to the railway company.

* See American Engineer, March, 1906, page 103.
† See American Engineer, Sept., 1906, page 362.
‡ See American Engineer, Aug., 1906, pp. 294, and Sept., 1906, pp. 331.

When the car was first put into service, 1.8 imperial gallons of oil were consumed per mile, but as the men gained experience in the handling of machinery, the consumption was reduced to 1.6 imperial gallons per mile; 5,000 gallons of water were evaporated per hour, giving a factor of one pound of oil to ten pounds of water. Experiments have recently been made on the testing plant at the Canadian Pacific shops with the same boiler and motor, using ordinary run of mine coal as fuel, instead of oil, with very satisfactory results.

Ganz Cars.—Motor cars of this type are being built for four different roads. * All-steel construction is used for the body, which has a seating capacity for fifty-two passengers. Total weight of car in working order is 70,000 pounds. This car is designed to maintain a speed of thirty-five miles per hour on a level track. Average fuel consumption is claimed to be from ten to twelve pounds of coal per mile.

MOTOR CARS ABROAD.

The development of motor cars abroad has made greater strides than in this country. Numerous English and Continental railway companies have permanently established rail motor car service in different localities with marked success. One may see such cars in operation on unimportant branch lines as feeders to trunk line trains; on main lines through thickly populated districts carrying passengers to and from more important towns served by express trains; on suburban lines in competition with trolley cars and steam trains and on an entire railway system where there is no other means of transportation except for heavy freight.

A brief description of the motor cars in operation on the principal railways of England and the Continent is given herewith, which will serve to show the developments of this type of motor car abroad. It is not the purpose of this report to enter minutely into the details of construction, but rather to show up in a general way the present situation.

GASOLINE MOTORS—MECHANICAL TRANSMISSION.

German Daimler Car.—The German Daimler gasoline car has been used in considerable numbers on some of the smaller German railways, notably the Wurtemberg State Railway and on the Swiss Federal Railway. It is a comparatively small car, having a total length of 33 feet, with a seating capacity of thirty-six. It is equipped with a 30 h.p. Daimler engine of the heavy, slow-speed type, its normal speed being about 550 r.p.m. The motor has four cylinders 5¼ inches diameter by 6¾ inches stroke. It is located in the middle of the car, attached to a subframe upon which the car body is supported by eight elliptic springs, the subframe being carried rigid on the two axles. Power is transmitted from the motor through a leather-faced cone friction clutch, and through a sliding gear transmission (arranged to give four speeds and reverse) to one of the axles. Control levers are provided at each end of the car, by means of which the speed of the motor, or the direction of motion, is controlled from either platform.

GASOLINE MOTORS—ELECTRIC TRANSMISSION.

North-Eastern Railway Car.—About three years ago, the North-Eastern Railway of England put into service two "petrol-electric" cars. The power plant consists of a four-cylinder horizontal opposed Wolseley gasoline engine † (8½ x 10 inches, 85 b.h.p. at 420 r.p.m.) direct connected to a compound wound, separately excited generator, of 55 kw. capacity, which furnishes current to two 50 h.p. electric motors, of the ordinary railway type, on the leading truck. The total weight, includ ng 60 gallons of gasoline and about 100 gallons of cooling water, is 35 tons, of which 22 tons are carried on the power truck. These cars are used during the summer season only. Three and one-half car-miles per gallon of gasoline is claimed for them. As this particular type of car has not been perpetuated by the original builders and users, it is safe to assume that it is not entirely satisfactory. The enormous size and weight of the power plant and the space occupied (being about one-third the total length of the car), are undoubtedly the reasons for discontinuing the construction of this design.

Arad & Csanadar Railway.—On the Arad & Csanadar Railway, in Hungary, a number of gasoline electric cars are used, the largest of which has a 70 h.p. gasoline motor direct connected to a 45 kw. generator, which supplies current to ordinary railway type motors attached to the two axles. The space occupied by the power plant is considerably less in proportion to the length of the car than that of the North-Eastern Railway, although the systems are practically identical in principle. The acceleration of the car is very good. Its maximum speed is about thirty-five miles per hour without trailer. It is claimed by engineers of this road that sixty-five per cent. of the motor's power is delivered at the wheels. Very satisfactory results are reported from these cars.

STEAM MOTORS.

Great Western Railway of England.—One of the most satisfactory cars in operation abroad at the present time is the one

* See American Engineer, April, 1907, page 141, and this issue.
† See American Engineer, Mar., 1906, page 88.

developed by the chief engineer of the Great Western Railway of England. In the neighborhood of sixty of these cars are in service on various parts of the Great Western System, and others are in course of construction. They combine to a remarkable degree many of those qualities essential to success, namely, large seating capacity with only moderate weight, flexibility of control, reasonable speed and acceleration, reliability, low maintenance and fair operating costs.

The boiler is of the vertical, fire-tube type with no superheater, supported directly on the frame of the power truck and serving as a center pin by transmitting the driving effort to the sills of the car through flat springs. It is enclosed within a compartment of the car body (about 14 feet long), which contains coal bunkers, operating levers, etc. As the car is arranged to run in both directions and controlled from both ends, a stoker is employed in addition to the driver. Aside from attending to the fire, it is his duty to regulate the cut-off when the driver is at the other end of the car, as only brake and throttle connections are provided there.

The motor consists of two single-expansion cylinders, 12 x 16 inches, coupled direct to the rear driving wheels, which in turn are coupled to the front drivers. Walschaert valve gear is used. The water supply is carried in tanks hung beneath the car body midway between the trucks. A maximum speed of fifty-five miles per hour can be obtained, although the average running speed is from thirty to thirty-five miles per hour. Their maximum acceleration is about one mile per hour per second.

Taff-Vale Railway.—The Taff-Vale Railway has built a number of cars for its own use* and for other railways, being similar in design to the Great Western car, the chief difference being in the construction of the boiler.

Lancashire & Yorkshire Railway.—The Lancashire & Yorkshire Railway† has cars similar to the Taff-Vale, in that the forward end is pivoted on the power truck. The boiler is of the usual locomotive type with horizontal fire tubes. This engine is practically a small locomotive with drivers coupled.

Ganz System.—Ganz cars are used rather extensively in Central Europe in three sizes, 35, 50 and 80 h.p. at 260 r.p.m. The general arrangement is the same in all three, the boiler being placed in a compartment at the forward end of the car, together with fuel bunker, feed pumps and controlling apparatus. The motor is placed horizontally on the leading truck, and drives the rear axle through spur gears. It is supported in the usual electric railway motor style, one end being swiveled above the axle, and the other supported elastically from the truck frame. The car is controlled from only one end and one man is required to operate it. The boiler consists of four concentric cylinders with headers (held in place by bolts) forming two annular water spaces joined together by means of slightly inclined steel water tubes, 25 mm. outside diameter and 2 mm. thick. Within the inner cylinder is another cylinder of slightly smaller diameter through which the fuel is fed to the grate below, the flame and hot gases passing around the water tubes to the stack. The motors are two-cylinder cross compound. The largest car, 80 h.p., weighs 23 tons, and is capable of climbing 1.6 per cent. grade, with two trailers weighing 12 tons each, at a speed of twenty-five miles per hour.

Purrey System.—The Paris-Orleans road has ten cars and twelve power trucks equipped with the Purrey system. This system has also been used for a number of years on different tramway lines in the city of Paris.

The Paris-Orleans cars have a total length of about 60 feet with a capacity of thirty third-class passengers in three compartments, and twenty-five first-class passengers in two and one-half compartments, and in addition there is a baggage compartment at the forward end 11 feet 6 inches long. The forward end is pivoted on the power truck, the rear end being carried upon a single axle. The total weight of this car is about 35 tons. The power truck which carries the boiler, motor, fuel, water, etc., has a 126-inch wheel base, the rear wheels only being used for driving. The Purrey boiler is tubular, consisting of two drums, the lower one of rectangular section and made of cast steel, the upper one cylindrical and of cast iron. The lower drum is divided into three compartments, two of which are provided for water, the third being for superheated steam. The outer and lower compartment is connected with the upper drum by two large return pipes. It is also connected with the intermediate compartment of the same drum by 41 U-shaped tubes. The feed-water entering the lower compartment is thus heated in passing through these tubes, which are in direct contact with the flame. From this point the water rises through a series of U-shaped tubes to the upper drum, and the steam thus formed is returned from the upper drum through a number of similar tubes to the third compartment of the lower drum, from which it is taken to the motor. The steam is highly superheated in these tubes, the average temperature of superheat being from 750° to 900° F. Coke is used for fuel, feeding automatically from a bunker attached to the side of the boiler, the supply being regulated by a vertical sliding door. The motor is a four-cylinder tandem compound, rated at 260 h.p. at 650 r.p.m. Ordinary D-type valves are used, operated through Stephenson link motion. In this design the motor is attached horizontally to the frame of the car and its power transmitted to the rear axle by two toothed chains of similar construction to the Renold and Morse silent type. As a rule, one or two trailers are attached to these cars, the average weight of the train being 50 tons. The fuel consumption of this train is about 21 pounds of coke per mile. The car is capable of maintaining a speed of about fifty-six miles per hour. The cost of operation per train-mile is about 7 cents.

Serpollet System.—The Serpollet system differs from the Purrey and Ganz types chiefly in that the boiler is of the flash type, and kerosene is generally used as fuel. A very high degree of superheat is obtained (reaching even 1,200° F.), which, together with the incrustation attending the use of more or less impure water, is conducive to the burning of tubes. The experience of the Paris, Lyons & Mediterranean Ry. with this type of car has been rather unsatisfactory, because of tube troubles, and the Purrey car is now being adopted in its place.

Komarek Car.—This car is used to some extent by the Austrian State Railway and several of its branches. This car is capable of running at a speed of 25 miles per hour on a level while hauling trailers comprising a total of 50 tons. The operating cost is said to be about 5 cents per train-mile (exclusive of the guard's pay) coal costing $3.25 per ton.

CONCLUSION.

That there is a field for the rail motor car cannot be questioned; its breadth at the present period being limited only by the development of the motor-car power equipment.

Steam, as a motive power, has always possessed the distinct advantage of flexibility of control as well as reliability.

The internal combustion motor within certain defined limits of horse-power sizes has been developed to that stage of excellence where these advantages cannot be said to apply exclusively to the steam engine.

With the experimental work that is being conducted in the development of the internal combustion motor using lower cost fuels than gasoline, and with promising results, who can predict the final outcome of the motive power that will be the most satisfactory from all points of view for the rail motor car? It is probable that both types will have their distinctive fields, depending upon the availability of the fuel.

A Form to Give the History of Locomotive Movements at Terminals.

Committee—G. M. Basford, chairman; H. M. Carson, C. E. Chambers, T. Rumney, J. E. Muhlfeld.

Co-operation between the mechanical and operating departments is always necessary, but it becomes vital during periods of congestion or when, for any reason, power is in great demand.

Your committee was instructed to propose a blank form for use at terminals, to give the history of the movement and time of every locomotive from the time of leaving a train until it takes another, the object being to secure closer co-operation between the mechanical and operating departments.

With this in view, a joint blank is submitted (see illustration), which is arranged in such a way as to necessitate co-operation in the record itself by rendering it necessary for each department to fill in the items, the control of which lies in its own hands. In this way each department may become conversant with the delays and the reasons for delays for which both departments are responsible.

It is recommended that the roundhouse and the yard shall use the same form, one for each twenty-four hours. Both the roundhouse and the yard should make its own entries in duplicate—an original and a carbon copy. Immediately at the close of the day, after midnight, the carbon copies may be exchanged and the record completed on each original copy. If sufficient force is available, the records may be combined or completed by a third party. By such a plan close co-operation may be expected, because the local head of each of these departments will, at all times, see that his own record is but part of the whole. Each of the officials will also see where his work fits into that of the other.

In the blank proposed, columns A to F, inclusive, indicate train and engine numbers, the name of the engineer and the time of arrival at the yard, the ash pit and the roundhouse.

If necessary, columns may be added to indicate whether the engine is in freight, passenger, switch or work service; but these are not recommended by your committee for use where they are not necessary.

Column G will show the time when orders for engines are received. This information may be important in checking the work of the roundhouse. Column H shows the time engines are promised, and column I when they are actually ready.

Columns J and K show the number and leaving time of trains for which engines are ordered. Columns L, M. and N show when engines leave the roundhouse, when they arrive in the yard and when they are coupled to trains.

* See AMERICAN ENGINEER, April, 1907, page 134.
† See AMERICAN ENGINEER, April, 1907, page 134.

THE A, B AND C RAILROAD.

DAILY RECORD OF LOCOMOTIVE MOVEMENTS AT ______________ TERMINAL,

______________ DIVISION,

FOR 24 HOURS, ENDING MIDNIGHT, ______________ 190

	ARRIVING						TO BE READY			DEPARTING								MECHANICAL DELAY		TRANSPORTATION DELAY	
	Train No.	Engine No.	Engineer	Time in Yard.	Time on Ash Pit.	Time at Round-house.	Time Order Rec'd	Promised	Ready	Ordered For		Left Round-house	Arrived in Yard	Coupled to Train.	Departed		Engineer	H. M.	Cause	H. M.	Cause
										Train No.	Time				Train No.	Time					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q				
Average:																					

Columns O, P and Q indicate the number and time of the departing train; also the name of the engineer.

In the remaining columns the delays, both mechanical and transportation, are indicated together with the reasons therefor.

On roads where clerical force is not available it may be desirable to have enginemen supply information for columns A, B, C, D, E, F, L, M and N. For this purpose a small blank form is presented—merely as a suggestion—as a part of this report (see illustration). One form may be used for arrival as well as

ENGINEMAN'S DAILY REPORT

FOR 24 HOURS, ENDING MIDNIGHT, ______________ 190

DIRECTION (East or West.)

Train No.	Engine No.	Engineer	TIME ARRIVING.			TIME DEPARTING.		
			In Yard.	On Ash Pit.	In Round-house.	Leaving Round-house.	Arrived in Yard.	Coupled to Train.
R	S	T	U	V	W	X	Y	Z

departure. For the arrival record the engineer should fill out columns R, S, T, U, V and W. For departure he should fill out columns R, S, T, X, Y and Z. Upon arriving at the ash pit on an incoming engine he should send the blank to the roundhouse, and upon coupling to an outgoing train he should leave another blank with the yardmaster. This information may then be easily transferred to either the roundhouse or the yard record, depending upon whether the engine is arriving or departing.

Your committee submits the record form with the recommendation that it be tried experimentally for a year by as many railroads as possible, with a view of gaining opinions from experience upon which to base further action of the Association upon this subject. We also suggest the advisability of securing the opinions of leading operating officials concerning such a blank form, whether or not these officials have an opportunity to put it into service.

It is also suggested that during periods of congestion an energetic man be placed at each locomotive terminal to follow up locomotive delays by aid of this form.

The blank form recommended herein should be understood as offering means for accelerating movements of locomotives when locomotives are greatly needed. Unless acceleration is especially desired, it seems inadvisable to stimulate action on the part of roundhouse forces to hurry the handling, inspection and, more especially, the repair work when there is ample opportunity to take sufficient time to improve the quality of maintenance and inspection and at the same time economize in the cost by eliminating overtime and other irregular work for which a premium must be paid. Your committee does not desire to recommend the continuous use of this blank form, except in cases where it may be necessary to increase the activity of terminal operations. Its occasional use to check locomotive service may, however, be exceedingly valuable.

The tendency toward placing an unnecessary burden by exacting unnecessary conditions from either the transportation or the locomotive department should be discouraged. One purpose of this blank form is to enable each department to help the other. It should not be the desire of either the motive power or the transportation department to show the other department that its own work is done and lies waiting. While such a case frequently brings abcut the desired result, it is an expensive matter for either department to carry on its work in such a way for the purpose of unnecessarily stimulating action on the part of another department.

In conclusion, your committee would point out the importance of introducing this form in service with a complete understanding on the part of all concerned that the necessary requirement is to reduce delays; that the purpose is to secure smooth, quick service; and that the blank is in no way intended as a means for placing responsibility upon another department. If each department will use it to improve its own performance, the desired result will be attained.

Tire Shrinkage and Design of Wheel Centers.

Committee—F. J. Cole, chairman; J. E. Muhlfeld, W. A. Nettleton, D. J. Durrell, W. L. Tracy.

Your committee made a report of Shrinkage Allowance for Tires in 1905 to this Association. The suggestions of the committee at that time were as follows:

Shrinkage 1-80th of an inch per foot in diameter for cast-iron and cast-steel centers less than 66 inches in diameter.

Shrinkage 1-60th of an inch per foot in diameter for centers 66 inches and over in diameter.

Minimum thickness of tires should be established, due consideration being given to the diameter, service and weight per wheel.

Tire and wheel gauges should be of good design, heavy enough to resist bending and subject to frequent inspection to insure accuracy.

Seventy-two inches diameter of wheel center should be included in standard sizes.

Wheel center rims should preferably be uncut, but, if cut, slots should be machined out and closed with solid cast-iron liners driven in. No lead or white metal to be used.

In the discussion which followed the reading of the paper the design of the cast-steel wheel centers was considered and a motion was made by Mr. Deems to refer the subject back to the same committee, and ask them to take into account the design of wheel centers and to consider principally the question of parted or solid rim, and whether retaining rings or shoulders on the tires should be used.

At the meeting in 1906 your committee submitted a report as requested, but unfortunately none of the members were present at the meeting, so that no definite conclusion was reached, nor was any one present to answer the questions which were raised in the discussion which followed the reading of the paper. In that report* definite recommendations were made and illustrated by sketches for the section of spokes and rim. The different forms of retaining rings most generally used were also illustrated and described. Answering the questions raised during the discussion: Mr. Brown criticizes the use of the lip on the outside of tire. This is used by the Pennsylvania Railroad in connection with their retaining segments, by the Canadian Pacific and other roads, and is quite largely used by builders for locomotives for export. The object is to prevent the wheel centers from being pushed through the tire in case it becomes loose. By inserting shims from the inside, as stated by Mr. Vaughan, no particular difficulty need be anticipated, and when it is remembered that the frames and other obstructions on the inside cover only a portion of the surface of the wheel, so that below and above the frames it is possible to insert the shims from the inside with but little inconvenience.

Mr. Fowler considered the differences in the hardness of tires and its effect upon the rolling-out action. The usual practice in rolling tires is to use a softer material for passenger tires, medium for freight and very hard for switching. The tensile strength and elongation given in Bulletin No. 14, American Society Testing Materials, is as follows:

Service.	Passenger. Lbs.	Driving. Freight. Lbs.	Switching. Lbs.	Truck and Trailing. Lbs.
Tensile strength per square inch not less than	100,000	110,000	120,000	110,000
	Per cent.	Per cent.	Per cent.	Per cent.
Elongation in two inches not less than	12	10	8	10

Regarding the use of retaining rings, your committee did not feel justified in recommending any particular form, on account of the great diversity of practice in their use.

Referring to the additional subject we have been asked to consider, namely, "Distortion of Wheel Centers and Tires Out of Round Due to Heavy Counterbalance," we are of the opinion that this whole question is so involved that it had better be made the subject of a separate committee. A great deal of work has been done in the past investigating the question of flattening of tires other than by sliding, and apart from the flattening action between the spokes which might result from a thin tire in

* AMERICAN ENGINEER, August, 1906, page 322.

combination with wheel centers having too light sections of spokes and rim, it does not seem to be a matter which need necessarily be discussed with the shrinkage of tires and design of wheel centers.

If the suggestions of your committee are generally adopted for the section of spoke and rim for cast-steel wheel centers, it will result in eliminating any possibility of distortion taking place from the above-named causes, as it will be generally found that wheels made from these suggestions will be much heavier than many designed some years ago, so that the last subject assigned could more properly be taken up and considered by a separate committee, with a view to saving time, which would allow some definite action to be taken at this year's meeting of the reports which have been submitted for the two previous years.

In conclusion, your committee would renew its recommendations made in 1905 and 1906, and the whole question, if considered advisable by the Association, may then be referred to letter ballot.

Superheating.

Committee—H. H. Vaughan (Chairman), Le Grand Parish, C. A. Seley.

There have been but few engines equipped with superheaters during the year 1906, with the exception of those constructed for the Canadian Pacific Railway. The following statement shows the engines in service December 31, 1905, and December 31, 1906, as reported by the members of this Association.

ROAD.	No superheaters. 1905.	No superheaters. 1906.	Type of engine.	Type superheaters.
L. S. & M. S.	0	1	2-6-2	Cole.
	....	1	2-6-2	Vaughan-Horsey.
C. B. & Q.	1	1	....	Cole.
	....	2	....	Schmidt smoke-tube.
Boston & Maine	0	1	4-6-0	Cole.
C. & N.W.	1	1	4-4-2	Cole.
	1	0	4-6-0	Cole.
M. St. P. & S. S. M.	2	1	....	Cole.
Rock Island System	2	2	4-4-2	Cole.
	4	4	4-6-2	Cole.
Canadian Pacific	1	1	4-6-0	Schmidt smoke-box.
	1	1	4-6-0	Schmidt smoke-tube.
	1	1	4-6-0	Schmidt smoke-tube.
	10	10	4-6-0	Schmidt smoke-tube.
	30	55	4-6-0	Cole return-bend.
	10	45	4-6-0	Vaughan-Horsey.
	5	5	4-6-0	Vaughan-Horsey.
	1	0	4-6-0	Cole field-tube.
	1	2	4-6-0	Vaughan-Horsey.
	0	16	4-6-2	Vaughan-Horsey.
	20	20	2-8-0	Schmidt smoke-tube.
	21	0	2-8-0	Cole field-tube.
	0	20	2-8-0	Vaughan-Horsey.

From this table it will be seen that on the railways in the United States there were 11 engines with superheaters at the beginning of 1906 and 14 at the end of that year, 2 having been removed and 5 applied, and on the Canadian Pacific Railway there were 101 in service at the beginning and 176 at the end of the year, 22 having been removed and 97 applied. It is also of interest to state that during 1907 the Atchison, Topeka & Santa Fe and the Pittsburg, Shawmut & Northern have each received engines equipped with the "Vauclain" type of smoke-box superheater and that Purdue University locomotive Schenectady No. 2 has been equipped with a "Cole" return-bend superheater.

The Canadian Pacific also have received or on order 176 additional engines, all of which are equipped with the "Vaughan-Horsey" superheater.

Coal Economy.

Of the roads using superheaters, the Minneapolis, St. Paul & Sault Ste. Marie and Rock Island are unable to give any figures on coal consumption. The other roads report as follows:

Lake Shore & Michigan Southern.—Coal and water consumption were measured on Class J-40 engines with and without superheaters on several trips, and the average results show a saving of coal of from 19 to 27 per cent. and of water of from 11 to 24 per cent. on the superheating engines.

Chicago, Burlington & Quincy.—The fuel consumption of engines equipped with "Cole" and "Schmidt" smoke-tube superheaters as compared with other engines of the same class, covering the months of October, November and December, is shown in the table below, the figures being pounds of coal consumed per 100 ton-miles:

	Oct. lbs.	Nov. lbs.	Dec. lbs.
Cole superheater engine 1989	17	15	17
Average consumption of 9 engines of same class	16	16	—
Average consumption of 11 engines of same class	—	—	18
Schmidt superheater engines 2098 and 2099:			
Engine 2098	19	21	23
Engine 2099	18	17	23
Average consumption of 18 engines of same class	19	—	—
Average consumption of 17 engines of same class	—	22	—
Average consumption of 27 engines of same class	—	—	22

Boston & Maine.—Comparative tests in heavy fast passenger engine service over hard division between one engine with "Cole" return-bend type and another of the same class but without superheater gave the following results:

	Superheated.	Saturated.	Per cent. Gain.
Ton-miles per 1,000 gallons of water	6366	5667	12.3
Ton-miles per pound of coal	5.16	4.5	14.7

The average superheat was 98.6°.

Chicago & North-Western.—Comparative tests made between identical engines of the 4-4-2 and 4-6-0 type, equipped with the "Cole" superheater and not so equipped, only such tests as were reliable being included, showed that the pounds of water per H.-P. hour were 7 per cent. less and the pounds of coal per H.-P. hour 9.2 per cent. less with the superheater than without it.

Purdue University.—Prof. W. F. M. Goss reports as follows: 'The experimental locomotive of Purdue University, which for several years has been operated as a simple engine using saturated steam, was last summer equipped with a 'Cole' superheater. In preparing the superheater it was desired that the extent of superheating surface should be made as large as practicable in order that experiments with the engine might involve as high rates of superheating as practicable, and to this end a larger sacrifice of direct heating surface was perhaps permitted than would ordinarily be the case.

"At this date the experimental locomotive has been operated 3,300 miles since equipped with the superheater. Under normal conditions of running with a wide-open throttle the steam delivered at the header is superheated from 120° to 190° F., the precise amount depending upon the rate of power at which the boiler is operated. It is least when the rate of power is lowest and greatest when the rate of power is highest. Between the header and valve box there is a loss of 30° superheat, due, of course, to the cooling effect of the cylinder.

"While the data for the tests in question have not been entirely worked up, enough has been done to show that the consumption of superheated steam per horse-power hour varies from less than 20 to about 22 as maximum, this performance being under a wide-open throttle and at such speeds and cut-offs as are practicable. These values are to be compared with those obtained when the cylinders are supplied with saturated steam, which will range from 24 to 27 pounds.

"There has been no trouble arising through leaks either in superheater or in the large flues which accommodate the pipes."

The figures thus given for steam consumption with the superheaters are 83½ per cent. and 81½ per cent. respectively of the consumption of saturated steam.

Canadian Pacific.—On account of the large number of superheater engines on this road and the close attention paid to fuel consumption a quantity of records are available of the results in road service, but they are not in many cases available for comparative purposes on account of the small number of modern simple engines in use. Previous to the introduction of the superheater, compounds had for some years been constructed for freight service and a comparison of the superheater with the compound is not entirely satisfactory, since it assumes that the compound is more economical than the ordinary simple engine, which may not always be the case. During the past year, however, the "Cole" field-tube superheaters were removed from the twenty-one engines of the M-4b class and they proved a very satisfactory and economical simple engine, and they can in many cases be used as a basis for comparison. (For the purposes of record a number of tables were given, showing the comparison of the superheater engines with the M-4b simples, the D-9 compounds and the M-1-2 and M-3 compounds.)

In general the above tables show satisfactory results for the superheater, but it is difficult to estimate from them any exact figures of the saving obtained.

In place of relying on records taken over a period of several months, a method of comparison may be employed which, while laborious, is accurate if carefully compiled, namely, by comparing month by month and section by section the amount of coal actually burned by any class of engine with that which it would have burned had it used the same amount per unit of work as the class against which its efficiency is to be measured. For example: in August, between White River and Schreiber the M-4a engines used 249 tons of coal at 127 pounds per 1,000 ton-miles while the M-4b used 263 tons at 130 pounds. Taking the M-4b as a basis, had the M-4a consumed the same amount

per 1,000 ton-miles they would have burned 272 tons in place of 249. By considering only those cases in which the class taken as a basis did sufficient work on any section in a month to render the comparison reliable, a series of results are obtained, which, when summed up give, over any required period and for any number of sections, the actual coal burned and the equivalent coal which would have been burned by any class of engine had its consummation been equal to that of the class with which it is being compared during each month on each section, subject only to the assumption that the unit conditions, as they may be termed, will equal. An advantage of this method is evidently that one favorable record has but little effect on the total result, and as each individual result is compared under similar conditions the sum total represents, with probably the greatest degree of accuracy that can be obtained from road records, the general result over a considerable period of time.

This method has been applied to the coal records on the Canadian Pacific where comparisons are possible, with the following results:*

Class of engine taken as basis, M-4b, freight service:

Section or division.	Class.	Coal used.	Equivalent coal.	Relative consumption.
Lake Superior	M-4a	8,474	9,414	90.0%
	D-10b	7,683	8,328	91.6%
	D-10c	....	....	90.6%
Newport-Montreal	D-10c	2,835	3,305	85.8%
	M-1-3	2,966	3,293	90.0%
	M-4e	220	342	64-2%
Megantic-Farnham	M-1-3	1,038	1,188	87.4%
	D-10c	2,548	2,920	87-3%
Field-Revelstoke	M-4e	7,536	8,830	85.3%

Class of engine taken as basis, E-5, passenger service:

Chalk River-North Bay	E-5de	1,617	2,015	80.2%
	G-1-2	915	1,012	90.4%
North Bay-Cartier	G-1.2	4,465	5,701	78.3%
Other Lake Superior	G-1-2	1,196	1,249	95.8%

Class of engine taken as basis, D-10c, freight service:

Eastern Division	D-10b	6,266	5,636	111.4%
Ontario Division	D-10b	6,315	5,816	108.6%

In these figures, neglecting M-4e between Newport and Montreal, where the amount of coal burned is insufficient to form a reliable opinion, there is evidently a saving in coal of from ten to fifteen per cent. in the case of freight engines. It should be noted that on the Lake Superior Division the M-4 class, other things being equal, should show a result about five per cent. better than the D-10, as on this division a consolidation engine, on account of the short one per cent. grades, is more economical than a 10-wheeler. This accounts for the D-10 engines which obtain a rather higher superheat than the M-4a showing only the same saving as compared with the M-4b. From Newport to Outremont the 10-wheel type is slightly the more economical, as there is a long grade on which the reduced capacity of this type results in an improved coal performance 14.2 per cent. and probably an average saving of 12 per cent. would perhaps be about correct. From Field to Revelstoke the service is very heavy, and the engine M-4e here compared to M-4b are the later type superheaters with 175 pounds pressure, and the resulting saving of 14.7 per cent. is very satisfactory.

An interesting result is the saving of 19.8 per cent. made by the E-5d as compared with the E-5. The E-5a engines are converted 10-wheel passenger engines of the E-5 class and are identical except as regards the superheater, and these results, together with the general experience on the Canadian Pacific, show that the saving in passenger service is greater than in freight.

The G-1-2 results are not of much value, as the Pacific type engine is of far greater capacity than the E-5, but on certain runs where the work done has not been much increased they have shown a very large saving.

The D-10b show a result substantially equal to the D-10c on the Lake Superior Division, but considerably poorer on the Ontario and Eastern Division, which is partly due to the leakage at the headers which developed in the latter case to a large extent, and is intended to show its action, which accounts for the poor results obtained on other roads when the same troubles have been experienced.

The records on the Canadian Pacific are fairly well in accordance with the tests on some of the other roads reporting and with those on the testing plant at Purdue. One fact is worth noting, that there is apparently a greater saving of coal than of water, the opposite of what might have been expected. This may be explained by the decrease in the efficiency of the locomotive boiler as the rate of evaporation increases, so that a saving of 10 per cent. in steam consumption decreases the rate of combustion to an extent which renders the boiler more efficient, and results in a still greater saving in the coal consumption. It might be objected that some of the reports show but little saving, and the experience on the Canadian Pacific would confirm this, as they are accompanied by complaints of the leakage occurring at the header, and in that case whatever saving was effected by superheating would be lost by the engine not steaming freely. In general it would appear that superheating may be stated to show a saving of 10 per cent. to 15 per cent. of coal in freight service and 15 per cent. to 20 per cent. in passenger service, a result that must be considered satisfactory if not quite as revolutionary as the earlier reports would have indicated.

Some tests that are of interest have been made on the Canadian Pacific showing the amount of superheat obtained, and are shown in Figs. 1 to 8 attached (not reproduced). Figs. 1 and 2 show respectively the results obtained in the M-4a with "Schmidt" smoke tube and M-4b with "Cole" Field tube superheaters. The former gives an average temperature of about 460°, while the latter showed but little superheat, and on account of the difficulty in keeping the tubes clean and the small advantage obtained the apparatus has been removed and the engines used as simples. In these tests the temperature was taken in the branch pipe, but in those following it has been taken at the steam chest. Figs. 3 and 4 show two tests in class E-5d and show a temperature of 540° and 560°. These engines have twenty-two 5-inch tubes in a 64-inch shell, the largest proportion of superheating surface so far tried, and have, as above mentioned, proved exceedingly economical and are reported to have a capacity of 5 per cent. to 10 per cent. greater than corresponding simple engines. Figs. 5 and 6 show tests of the D-10b and Figs. 7 and 8 of the D-10c engines, both having twenty-two 5-inch tubes, the former with "Cole" and the latter with the "Vaughan-Horsey" superheater, the arrangement, with the exception of the headers, being practically identical. The former show temperatures of 460° to 470°, the latter 500° to 510°, the difference being due either to the more completely separated headers, or to the more even flow of steam.

Experiments have also been made to determine the loss in pressure through the superheater, and in an engine having twenty-two tubes each containing two return bend elements, and either of the M-4 or D-10 classes, it is found to be about 5 pounds under general working conditions.

MAINTENANCE.

All roads reporting, with the exception of the Lake Shore & Michigan Southern, have experienced considerable difficulty with the joints between the main and sub-headers on the "Cole" superheaters leaking, and this unfortunate defect has been a very important factor in the lack of interest shown in superheaters generally. On the Canadian Pacific, where a large number have been in service, the delay to power and failures through engines not steaming has been most serious, the more so since at first no trouble developed. It is probably due to the shock in starting and switching causing the weight of the superheater pipes to work the sub-headers backward and forward and thus start the joints, and when once started the escaping steam cuts both the gasket and the seats away rapidly, and when once the latter are injured, remaking the joints is a tedious and difficult matter. It is also a peculiarity of the "Cole" superheater that it can leak very badly at the header joint and yet not affect the steaming qualities of the engine sufficiently to prevent its taking a train, and while this is an advantage in one respect it means, in busy times, that the joints are liable to get into a rather bad condition before they are attended to. Attempts are now being made to overcome this difficulty by securing a heavy angle-iron across the smoke-box at the bottom of the headers, and fastening them to it so as to prevent their movement, also by increasing the bolting at the joints, and it is believed that this will remedy it.

The "Schmidt" superheater has, on the Canadian Pacific, given, in the majority of cases, exceedingly good results and has run from shopping to shopping without attention. When for any reason the joints start it is very difficult indeed to get them tight without going over the face of the header and facing up the flange joints anew, and this work is slow and means considerable delay in a roundhouse. Should any leakage occur at a return bend there is also considerable work to make repairs if the leak occurs in the top or second row of pipes, on account of

* For further dimensions of these locomotives see AMERICAN ENGINEER AND RAILROAD JOURNAL, May, 1906, pp. 161.

having to take down the bottom row to get at the others and having to make the joints over again in putting it up.

It takes two or three days to make the entire set of joints when the faces are in good condition, but this time may, of course, be increased if the joints have been leaking and the faces are cut, and the job is then a serious one.

The "Vaughan-Horsey" superheater gave considerable trouble at first, on account of the fittings and nuts being made of bronze, which softened under the high temperature in front of the superheater tubes and frequently gave out. During the past nine months these fittings and nuts have been made from steel forgings and this difficulty has been overcome. Some of the upset ends of the superheater pipes also broke off, but it was found that this was caused by the method of manufacture and they are now made in two operations with satisfactory results. Some pipes have pulled out of the return bends, caused by sufficient attention not being paid to their length being correct, and they are now made as closely alike as the threads permit, namely, within ¼ inch, and the longer pipe is attached to the upper header so as to equalize the difference in expansion. The only difficulty now being experienced is an occasional loosening of the nuts, and while this is not serious it is annoying, and has led to an occasional engine failure. A simple form of lock-nut is now being used which will prevent this, and it is hoped that this type of superheater will not add to an appreciable extent to the ordinary troubles of a locomotive.

There have been a number of cases of leakage at the return bends caused by a peculiar deterioration of the small pipes. This is due to the dampers not being properly maintained and allowing the tube ends to become overheated. After this is continued for several months the metal in the tube loses all its strength and can be broken by hand. The obvious remedy is, of course, the proper maintenance of the dampers, and this will require a better designed arrangement than has been employed in the past. There is not much difficulty in overcoming these troubles, but it may be stated that dampers must be operative or there will be trouble with the superheater pipes. In the "Vaughan-Horsey" design this is not very serious, as a leaky or defective pipe can be pulled out in a couple of hours, the joints blanked and the pipe put back when repaired at next washout, but with the "Cole" and "Schmidt" design it means taking down one or several sets of pipes with the chances of disturbing the joints on the remaining sets and very possibly a good deal of work to get everything tight again. In this connection it may be mentioned that possibly the present practice of making these pipes of solid drawn steel tubing is wrong. Iron tubing would be less affected by the heat than the steel and this material is to be tried in place of it. The large five-inch tubes have given very little trouble; in fact, in bad water districts in the West, they have been allowed to run through two sets of two-inch tubes with satisfactory results. There have been a few cases of their breaking at the threads, which has raised the question as to whether it is actually necessary to screw them into the back tube sheet, but this has not yet been decided.

The stopping up of the tubes seems to have been a peculiarity of the Field tube design. Probably the extreme end of this tube, which was not thoroughly cooled by the steam, became overheated and allowed a deposit to form on it. With the return bend type, even when using the same class of fuel that gave trouble with stopping up with the Field tubes, there has been no trouble except on the Chicago, Burlington & Quincy, so that it would appear that, with the majority of the coals in use, this difficulty is not serious.

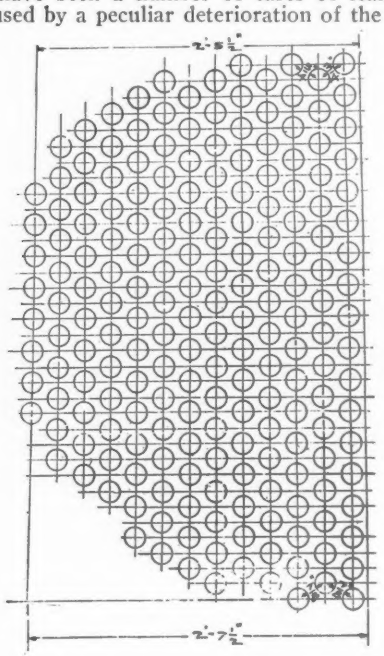
Cost of Repairs.

The Chicago, Burlington & Quincy.—The experience with superheaters on this road was very unfortunate. The header on the locomotive with the "Cole" superheater could not be kept tight, and trouble was experienced with the "Schmidt" superheater, both with the joints between crotch pipe and the dry pipe and with the gasket joints on the superheater pipe flanges. They have also had several pipes break at the return bends and all round have had an excessive amount of trouble that would indicate the superheaters were not applied with sufficient care in the first place.

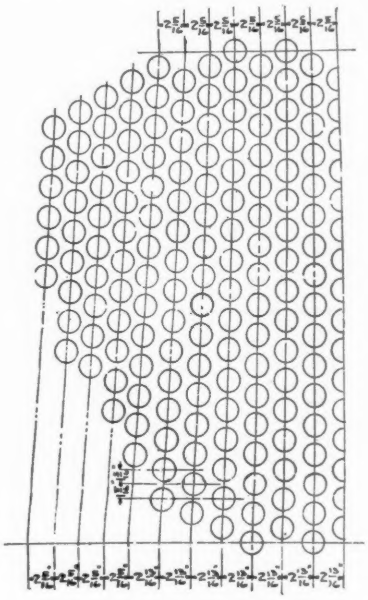
Canadian Pacific.—The cost of repairs to superheater engines on the Canadian Pacific has not shown any serious increase over simples.

Lubrication.

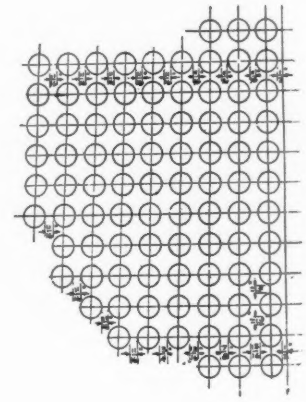
The idea that forced feed lubrication was necessary with superheated steam proved to be entirely wrong. It is true that insufficient oil produces bad results more quickly with superheated than with saturated steam, but the sight-feed lubricator is equally as satisfactory with the former as with the latter and, in fact, rather better on account of the drop in pressure on account of the steam being wire-drawn in passing through the superheater. Satisfactory results are obtained with one feed to the valve chest branching into the bushing at each end of the valve, although on the Canadian Pacific one feed is used to each end of each valve. A separate feed to the cylinder is necessary, at any rate, with the quality of oil at present employed, and experiments are necessary with other grades of oil before stating what will finally be required. With good lubrication at present there is a rather faster wear of piston and valve packing rings with superheated than with saturated steam, but the difference is not serious.



Vandalia R. R.
Sketch No. 1.



The Minneapolis & St. Louis R. R. Co.
Sketch No. 2.



Central R. R. of New Jersey.
Sketch No. 3.

Proper Spacing of Flues in High-Pressure Boilers.

Committee—C. E. Fuller, Chairman; H. J. Small, F. J. Cole, John Tonge, O. H. Reynolds.

Thirty-two members answered the questions in the circular sent out by the committee. The answers to three of these questions were as follows:

What size bridge do you recommend for good-water district? About 53 per cent. recommend bridges ¾ inch wide. Two members recommend arrangement as per sketches 1 and 2.

What size bridge do you recommend for bad-water district? Sixty-two per cent. recommend bridges from ⅞ inch to 1 inch wide. Three members recommend arrangement as per sketches 1, 2 and 3.

What arrangement of flues do you recommend? Over fifty per cent. recommend the common arrangement of flues. Three recommend special arrangement, sketches 1, 2 and 3. Two think the arrangement of flues is immaterial.

One of the members recommends very strongly a special arrangement, as shown on sketch No. 2, an arrangement which they have used successfully for a number of years, but no spe-

cial tests have been made to determine the efficiency as compared with boilers having the common arrangement of flues, although they are positive it is a great improvement over it. To determine the proper spacing of flues, this subject must be considered from the transportation as well as the mechanical standpoint; that is, the engine failures on account of leaky flues, as well as the cost of maintenance and steaming qualities of an engine, must be considered. The committee is of a uniform opinion that wider bridges, from ⅞ inch to 1 inch, or even wider, should be recommended, but before determining exactly what size bridges should be used they consider it advisable that a series of tests be made to determine the water circulation between flues, the coal consumption for boilers with different size bridges, as well as the cost of maintenance in regard to flues.

Blanks for Reporting Work on Engines Undergoing Repairs.

Committee—Theo. H. Curtis (Chairman); E. W. Pratt, C. H. Quereau, F. W. Lane.

Your committee appointed to recommend "Blanks for Reporting Work on Engines Undergoing Repairs" presumes that it was intended that this report should embrace blanks for reporting engines which are in service but need shopping, and blanks for reporting work done on engines which have undergone repairs, to be used as a permanent record. We have also presumed that the report is to cover shop repairs and not running repairs.

Under the present method of making heavy or extensive repairs to engines at one or two main shops, and of making only light or running repairs at the small division shops or terminals, and of running engines out of terminals in either direction in pool service, and where division master mechanics have no regular assignment of engines and, therefore, cannot be held entirely responsible for the condition of engines on their respective divisions, the most important and essential feature in connection with the cost of repairs of locomotives and the results of operation is that of obtaining a correct and accurate report of the condition of engines in service, that they may be sent to the shops best equipped to do the class of repairs which they need, and that the condition of the engines on the various divisions may be kept consistent with the service required.

In order to assign engines to the shops intelligently, an accurate report of their condition and a comprehensive classification of the repairs required is necessary. Your committee does not believe that the classification of locomotive repairs recommended by the committee which reported at the last convention, is best adapted for this purpose.

The operating officials in all departments are gradually adopting the use of the classification in vogue in the motive power

A. B. and C. RAILROAD COMPANY.

Mr.______________

Supt. of Motive Power ______________Division, __________190

____

Engine No.______________requires the following repairs and should be shopped during the next thirty days. Estimated class of repairs needed______________

ENGINE PARTS	WORK REQUIRED
Boiler . . .	
Fire Box . . .	
Flues	
Frames . . .	
Wheel Centers . .	
Axles, Driving .	
Cylinders . . .	
Crank Pins . .	
Driving Boxes .	
Tires	

REMARKS.—(State other heavy work required not shown above.)

*LAST SHOPPED.—Date__________190 Place______________Class repairs

Mileage made since last shopping______________miles.

SHOPPING APPROVED:

______________ ______________

Supt. of Motive Power. Master Mechanic.

Ordered to______________Shops, Date______________190

____

Supt. of Motive Power

*Information regarding "last shopped" and mileage made will be inserted in Supt. of Motive Power's Office.

NOTE—Original of this report will be sent to the Master Mechanic of the Shop to which the engine is assigned when the assigment is made. Duplicate report will be filed in Supt. of Motive Power's Office.

Exhibit "A."

FORM 928.—Revised 2, '06

A. B. and C. RAILROAD COMPANY

OFFICE OF MASTER MECHANIC.

REPORT OF ENGINES REPAIRED AND UNDERGOING AND WAITING REPAIRS.

______________Shops, week ending______________190____

ENGINES TURNED OUT OF SHOPS

Engine No.	Date Taken in	Date Turned out	Class of Repairs	REMARKS

ENGINES IN SHOPS

Engine No.	Date Taken in	Date will Probably be Turned out	Class of Repairs	If delayed Waiting Material, State Briefly what it is and Date and Number of Requisition on which Ordered.

Engines Out of Service, Waiting Repairs Account of No Room in Shops

Engine No.	Date Taken out of Service	Class of Repairs	REMARKS

If there are facilities and space in shop available for repairs to Engines, state how many Engines could be accommodated if they could be spared from service.

____

MASTER MECHANIC.

CLASSIFICATION OF LOCOMOTIVE REPAIRS.

$ 100.	—Cost of Repairs—Class	1
300.	— " " " — "	3
700.	— " " " — "	7
1,000.	— " " " — "	10
1,500.	— " " " — "	15

Exhibit "B."

department on their respective roads, particularly with regard to engines in shop for repairs, and the classification should, therefore, be one that is free from complication and easily understood. In addition to the classification recommended by the committee at the last convention being complicated, it costs considerable more to make repairs in some cases than in others, though the classification is the same. We believe the most practical and comprehensive classification is the unit classification, based on the estimated cost of repairs, and have, therefore, used it in connection with the blanks recommended in this report. Under the unit system engines requiring repairs estimated to cost $100 are termed class "1" repairs; $500, class "5" repairs; $800, class "8" repairs; $1,500, class "15" repairs; $3,000, class "30" repairs, etc. We also consider a more detailed report than the mere classification number (under any system of classification) is necessary in order to intelligently assign engines to the shops for repairs.

In order not to hold engines out of service awaiting room in the main shop, it cannot be left to the discretion of division officials to forward engines to the main shop. They should be assigned to the shops by the head of the mechanical department, or one delegated by him to perform this duty. A record of the mileage made by each engine beween shoppings and the repairs made to the engines at previous shoppings, as well as accurate reports of the condition of engines and a knowledge of the service required on each division, is essential to intelligently make shop assignments and secure the longest and best possible service at reasonable cost.

Your committee obtained from the heads of the mechanical departments of the principal roads forms in use for this purpose and, after a careful analysis of the subject and the forms submitted, recommend the use of the following blanks:

1 (Exhibit A). Blank showing condition in detail of engines which will require shopping within thirty days. This report is in duplicate form and that part pertaining to the condition of the engine is made by the division master mechanic where the engine is in service and forwarded to the head of the mechanical department. The information relative to date, place and class of repairs, and mileage made since last shopping is inserted in the superintendent of motive power's office, and if the shopping

CLASS ....
BUILT AT ....
DATE OF SERVICE ....

A, B AND C
RECORD OF LOCOMOTIVES

	Where Overhauled	In Shop			Out of Shop			Mileage Since Last Shopped	Labor		Cost of Material	Total Cost	Cost Due to Accident	Boiler	Fire Box	Flues	
		Day	Mo.	Year	Day	Mo.	Year		Boiler	Machinery							

Exhibit F, Part 1.

RAILROAD COMPANY.
OVERHAULED.

ENGINE No. ....

	Flue Sheet	Stay Bolts	Frames	Wheel Centers	Driving Axles	Cylinders	Driving Boxes	Tires	Cab	Tender	Brakes	

Exhibit F, Part 2.

is approved the engine is ordered to the shop best adapted to do the work and at such time as it can be relieved and space can be assigned it in the shop. The original report will, at that time, be sent to the master mechanic or superintendent of shop to which the engine is assigned for repairs, and the duplicate report filed in the office of the superintendent of motive power as a permanent record. The master mechanic making the report should be held equally responsible with the master mechanic making the repairs for failure to report repairs needed to essential parts, if they are not made.

2. Blank (Exhibit B) is a weekly report to be made by each master mechanic to the head of the mechanical department, showing "Engines Turned Out of Shop," with date taken in, date turned out, and class of repairs made; "Engines in Shop," with date taken in, date will probably be turned out, class of repairs, and, if waiting on material, the items, date and number of requisition upon which it is ordered; "Engines Out of Service, Waiting Repairs Account No Room In Shops," with date taken out of service, and class of repairs needed; "Available Track Room in Shop for More Engines," with number of additional engines that can be taken in shop.

From these reports a very concise statement (Exhibit C) can be compiled to be submitted to the heads of the operating department, but a printed form is not desirable for this statement as it can (on account of the varying number of engines in shop) be made on typewriter in more concise form.

A, B AND C RAILROAD COMPANY.

ENGINES TAKEN IN SHOPS WEEK ENDING APRIL 27, 1907.

Engine No.	Date Taken In.	Date Will Probably Be Turned Out.	Class of Repairs.
......Shops.			
779	April 8	May 7	15
2061	April 8	May 17	18
341	April 20	May 20	18
......Shops.			
273	April 12	April 30	10
2023	March 23	April 30	20
539	April 20	April 30	15
1111	April 26	May 3	4
719	March 23	May 4	28
547	April 24	May 4	12
137	April 20	May 4	26
166	April 20	May 7	15
400	April 1	May 8	20
2012	April 27	May 10	15
920	April 23	May 11	23
31	April 15	May 11	18
887	March 23	May 11	33
343	April 9	May 11	20
768	April 26	May 14	15
724	April 25	May 15	18
918	April 3	May 18	40
604	April 20	May 20	35
806	April 15	May 20	40
......Shops.			
608	April 2	April 30	18
1049	April 22	May 1	2
607	March 26	May 7	21
266	April 8	May 7	16
503	April 20	May 9	18
764	April 12	May 16	19
959	April 23	May 20	17
......Shops.			
1088	April 21	April 27	1
332	April 11	April 30	3
453	April 25	May 3	1
361	March 23	May 4	10
129	April 15	May 15	7

Engine No.	Date Taken In.	Date Will Probably Be Turned Out.	Class of Repairs.
......Shops.			
754	April 26	April 30	1
446	March 14	May 4	12
201	April 24	May 4	3
642	April 10	May 10	12
......Shops.			
987	March 27	April 30	20
1068	April 10	April 30	7
718	March 30	May 2	18
153	April 22	May 4	5
1014	April 21	May 8	7
1055	April 21	May 11	7
924	April 4	May 15	22
1003	April 6	May 15	25
109	April 21	May 16	13
984	April 19	May 18	20
612	April 19	May 22	20
438	April 26	May 25	22
......Rd. House.			
262	April 22	April 24	1
1162	April 22	April 25	1
416	April 21	April 26	1
133	April 26	April 29	1
......Shops.			
58	April 24	April 26	2
329	April 19	April 29	5
123	April 5	May 1	8
330	April 24	May 4	5
529	April 24	May 6	5
1	April 5	May 20	20
......Shops.			
2072	April 26	April 29	1
119	April 21	April 30	2
......Shops.			
2020	April 22	May 2	6

ENGINES TURNED OUT OF SHOPS WEEK ENDING APRIL 27, 1907.

......Shops. 41, 225, 640.
......R. H. 262, 416, 1162.
......Shops. 116, 118, 627, 774, 879, 897, 1081.
......Shops. 704, 870, 930, 1031, 1062, 1067, 2032, 1145.
......Shops. 543, 900, 2059.
......Shops. 442, 2014, 1088, 1089.
......Shops. 68, 2105.
......Shops. 605, 712, 713.
......Shops. 960

OFFICE OF SUPT. MOTIVE POWER,
.. ...., April 29, 1907.

....
Supt. Motive Power.

Exhibit "C."

3 (Exhibit D).* Blank showing in detail repairs made to the various parts of engines, dates in and out of shop, mileage since last shopping, cost of repairs (with that due to collision and accident shown separately), and other general information which is of interest as a permanent record.

4 (Exhibit E).* Blank showing in detail stay-bolt test and fire-box inspection and renewal of stay-bolts. This blank is supplemental to blank Exhibit D, and is an essential record which cannot practically be incorporated in blank Exhibit D.

5 (Exhibit F). Blank showing continuous shop record, mileage, cost* of repairs of each individual engine. This is a permanent record for use in the superintendent of motive power's office and the information is obtained from reports made on blanks Exhibit D, as furnished by the various division master mechanics.

All of the foregoing blanks should be made of loose leaf form, that they may be bound in suitable binders. Blanks A, D, E and F should be bound with engine numbers in consecutive order and each fiscal year in separate volumes. Blanks C and B should be bound in order of date.

Many of the railroad companies submitted numerous blanks used by them in connection with shopping and repairs to engines, but we believe that a complicated system of numerous reports is expensive and undesirable and that the foregoing blanks are sufficient to furnish a practicable and permanent record of work done on engines undergoing repairs.

MASTER CAR BUILDERS' ASSOCIATION.

Forty-first Annual Convention.

ABSTRACTS OF COMMITTEE REPORTS.†

Height of Brake Staff.

Committee—E. A. Miller, chairman; J. E. Keegan, F. T. Hyndman.

The committee recommends that the standard maximum height from rail to top of brake staff be 14 feet and the standard distance from center of car to center of brake staff be from 18 inches to 20 inches.

Triple Valve Tests.

Committee—A. J. Cota, chairman; F. H. Scheffer, R. K. Reading, E. W. Pratt, James Macbeth.

No new triple valves have been presented for test since the 1906 meeting. The committee has decided that it will be impracticable to conduct a series of tests which will allow them to revise the present code of triple valve tests until they have the opportunity of conducting tests on the new M. C. B. 100-car rack. The Westinghouse Air Brake Company has furnished a blue-print showing the details for a 100-car testing rack with estimate of cost. This has been referred to the executive committee.

Arch Bars.

Committee—C. A. Seley, chairman; S. N. Dow, J. J. Ewing.

The committee was instructed to consider what changes in the dimensions and shapes of the standard arch bars would be necessitated if the truck wheel base should be changed from the present standard of 5 feet 2 inches to 5 feet 6 inches in order to better accommodate inside hung brakes, the matter of the angularity of the brake hanger also to be considered.

The committee, after consideration and investigation of the practice and results on various railroads, is of the opinion that the sizes of sections used on the present standard arch bars, namely, 1½ x 4½ top, 1⅜ x 4½ bottom, and ⅝ x 4½ tie bars

* Not reproduced.
† Continued from page 283, July number.

may be used safely in trucks for 80,000 pounds capacity, cars having 5 foot 6 inch wheel base; the increase of the stress due to the greater spans is not sufficient to warrant an increase in the sections.

It is the opinion of the committee that the bends next to the columns are too closely spaced, as, with the present arrangement, there is but 13-32 inch between the edge of the holes and the beginning of the bend. The committee recommends that the spacing of the bends be increased from 18½ inches to 20-inch centers, and that the horizontal distance between bends be increased from 16¼ inches to 17½ inches.

The committee also suggests that the turned-up lip on the ends of tie bars are unnecessary, and recommends that they be eliminated, the total length of the tie bar to be the same as the arch bars, or 74 inches over all.

Regarding the double nuts shown on column bolts, the committee suggests the addition of a note to the drawing, reading as follows: "A single nut with a nut-lock or a cotter may be used instead of double nuts."

The utility of the column bolt washer has been questioned and the committee suggests that the washer or its equivalent is desirable in order to provide suitable clearance for a fillet under the column bolt head. It recommends that a note be added to the drawing, reading as follows: "Column bolt washers may be omitted if bolt holes in the top arch bars are countersunk."

The committee approves the suggestion of the committee reporting on brake beams to the convention of 1906, which reads as follows: "That brake hangers should have an angle as nearly as possible to 90 degrees from a line drawn from the center of the brake shoe to the center of the axle, when the shoes are half worn."

Stresses to Which Wheels for 100,000-pound Capacity Cars are Subjected.

Committee—J. F. Walsh, chairman; E. D. Nelson, O. C. Cromwell, G. E. Carson, W. J. Buchanan.

The committee finds the subject assigned it a rather difficult one to report upon intelligently. There are a number of features in connection with it, which, in our opinion, could best be handled by being placed in the hands of specialists, such as at the plant at Purdue University, Lafayette, Indiana, or the Pennsylvania Railroad Company at Altoona, Pennsylvania.

We must consider:

Stresses Due to Load Imposed.—As the present pattern of cast-iron wheel has the tread coned to a very much greater extent than the old type of wheel, it must, in our opinion, result in an excess of pressure on the wheel tread, resulting in a local deformation of that part of the wheel in contact with the rail; and these stresses recurring persistently, as the wheel revolves, tend to produce a fracture.

The Stresses That Wheel Flanges Are Subjected to When the Train Enters a Curve.—The extent of these stresses depends on the curvature of the track, the speed of the train, the weight of the load the car is carrying. The location of the center of gravity of the car also has its effect.

The Effects of Brake Shoe Application and the Form of Brake Shoe.

We believe all of these things could be handled to a very much better advantage by those who are especially equipped for making the necessary tests.

Tests of the M. C. B. Couplers

Committee—R. N. Durborow, chairman; G. W. Wildin, F. W. Brazier, F. H. Stark.

During the past year the standing committee on tests of M. C. B. couplers has made a thorough investigation of the breakages and failures of steel couplers with the view of obtaining some reliable data concerning the location and nature of such fractures, and to recommend such changes as will strengthen the couplers in the weakest parts, improve them, and to reduce the failures to a minimum. An examination was made of approximately 5,000 broken steel couplers and 3,000 broken steel knuckles, together with the locks or their substitutes, of the more prominent types of couplers. (The results of this inspection are shown diagrammatically in Sheets "A" to "M," inclusive, not reproduced.)

The couplers represented were not all M. C. B. standard, that is to say, only about six of the types shown on the diagrams had been tested under the M. C. B. specifications to a greater or less extent during the last two years. The latest type of couplers which have been on the market for a year or two are not shown, inasmuch as an insufficient number of these later designs were found broken to compare them with accuracy.

BREAKAGE OF 5 X 5-INCH SHANK COUPLERS.

Lug Breakage.—In the 5 x 5-inch shank couplers, the lug breakages have decreased in the later type of couplers, which can be attributed to the strengthening of the lugs in design by the manufacturers, and the increased amount of metal which was added when the contour lines were last changed. The upper lug breakage has been the most serious of the three breakages grouped under this head, which can be accounted for by the fact that most lug breakages are caused by broken knuckle pins, the lower half dropping out and the upper half remaining in the head. In three types of couplers, the breakage just back of upper lug was greater than through the upper pivot pin lug, which can readily be overcome in the design.

Face Breakage.—The face breakage is generally on the increase and is by far the greatest point of failure in the coupler, and it is evident that the strength of the face has not kept pace with the increasing forces which affect it. This in part results from the greater amount of attention the lugs and the shank have received in the design, and is further accounted for by the lack of room to strengthen the section, which is limited to some extent by the space occupied by the locking mechanism, particularly with the bar type of locks. Breakage through the face into the locking-pin hole, is by far the most prominent, which is to be expected, as this is the most limited section. The guard arm breakage has run very evenly except in isolated cases, the box and rib design showing no general difference in their failures. The fracture through the upper corner of the guard arm is negligible without exception.

Shank Failures.—The shank failures appear least on the early modern couplers, while on the later types they are on the increase. This increase is chiefly due to bent shanks, but the breakage back of the head has also shown an increase, while the breakage immediately in front of the butt is also in the ascendancy. In almost every case of couplers having bent shanks the bend is in the vertical direction. It is believed that the shank failures can be materially reduced by more attention being given the individual design of the coupler by the manufacturer.

Breakage of Side-Wall and Across Horn.—Of the two odd breakages, the one through the wall behind the knuckle has been quite large in three types, but is on the decrease in the latest types of couplers. The committee feels that there should be no breakage at this point, as there should be little strain, and the design can be changed to provide for any strength necessary without affecting any other vital part of the coupler. The breakage at the horn has been low, with one exception. As an emergency stop the horn should be designed strong enough to withstand the shocks, but with the introduction of properly designed draft gears of sufficient capacity, the trouble from horn breakage should disappear.

BREAKAGE OF 5 X 7-INCH SHANK COUPLERS.

Lug Breakage.—On 5 x 7-inch shank couplers, which are all modern, lug breakages show an even greater decrease on the later types than on the 5 x 5-inch shank couplers, and with the three exceptions are below ten per cent. of the total breakages. Most of these couplers are equipped with the knuckle tail hook to prevent the knuckle from pulling out when the pivot pin breaks, which assists in preventing the lugs from breaking.

Face Breakage.—The face breakages are by far the most prominent and are considerably above fifty per cent. of the total breakages. The breakage into the face through the locking-pin hole and the breakage at the neck of the guard arm constitute the largest percentage of the failures, and these two breaks vary in the different types of couplers; in some makes the breakage through the face into the lock-pin hole is the most numerous, whereas, in the other types, the neck of the guard arm is broken more frequently. The failure of the upper corner of the guard arm has become negligible.

Shank Failures.—The shank failures in three instances are above ten per cent. of the total failures, and this is mainly due to bent shanks. The breaks immediately behind the horn and directly in front of the butt are rather constant for the different types of couplers and about uniform in the two breaks, both of which are very low, only one case reaching seven per cent. of the total failures.

Breakage of Side Wall and Across Horn.—The breakage through the side wall of the head behind the knuckle tail is excessively high in two cases, one type showing twenty-eight per cent. and the other type twenty-one per cent. of the total failures. The breakage across the horn through the locking-pin hole has almost disappeared, probably due to the more efficient draft gears applied with these couplers on the later cars, which prevent the horn from coming in contact with the end sill.

COMPARISON OF THE BREAKAGES OF THE 5 X 5-INCH AND 5 X 7-INCH SHANK COUPLERS.

In making the following comparisons, it must be remembered that they are only relative and not comparative:

Shank Failures.—The percentages of the shank breakages of the 5 x 7-inch shank couplers average less than three per cent. lower than the shank failures of the 5 x 5-inch shank couplers. Bending has been the most serious failure of the shank in the late types, and as the shank generally bends vertically, we do not obtain the full benefit from the additional 2-inch width of shank, as the additional metal is not in the right direction to stop the vertical bending most effectively.

Face Breakages.—The percentages showing the combined breakages of the face are slightly lower for the 5 x 5-inch shank

couplers, but the breakage through the face into the locking-pin hole is lower on the 5 x 7-inch shank couplers. This is accounted for by the increased width of the shank backing up the guard arm, the benefit accruing directly to the section forward of the locking-pin hole, as it will be noted that the guard arm failures in the 5 x 7-inch shank couplers are very much higher than the 5 x 5-inch shank guard arm failures. The results show, without question, that the weakest point of the couplers is in the section of the face immediately forward of the locking-pin hole. The neck of the guard arms should also receive further consideration in the way of strengthening.

BREAKAGE OF KNUCKLES.

The breakage of the solid knuckle is not confined to any particular point, but may be said to vary with the construction of the knuckle, the main failures being breakage at the pivot pin hole, the knuckle tail behind the lock bearing, breakage of the knuckle tail bearing and breakage of the coupling lug.

Breakage at Pivot Pin Hole.—The combined breakage at the pivot pin hole is divided into the breakage through the pivot pin hole and the breakage through the tail immediately behind the pivot pin hole shoulder. The breakage behind the shoulder is the more serious in some knuckles than the actual breakage through the pivot pin hole.

Knuckle Tail Behind Lock Bearing.—The breakage of the knuckle tail behind the lock bearing, or in other words, of the hook which prevents the knuckle from pulling out when the pivot pin breaks, has been pronounced, all but two of the solid knuckles represented being equipped with this safety device. The breakages show the value of the knuckle tail hook as well as the weaknesses. It will be difficult to strengthen this hook in most knuckle-throwing couplers, but it should be done wherever possible.

Breakage of Coupler Lug.—Lug breakage has diminished from the most prominent failure in slotted knuckles to one of minor importance in the solid type. A number of the fractures were the direct result of improperly designed cores, and of cores slipping when casting knuckles which have lightening cores through the lug.

DEFECTIVE METAL, POOR CORING, ETC.

The percentage of defective castings among the 5 x 5-inch shank couplers has decreased with the development, and the types which have been tested most generally under the M. C. B. specifications show the least percentages. This also holds true in the 5 x 7-inch shank couplers, where, with one exception, the tested couplers when broken have shown less defective metal than those not tested.

IMPROPER REPAIR PARTS.

In examining the broken knuckles and defective locks, your committee has found that many knuckles and locks have been purchased for repairs which were manufactured by steel foundries other than the makers of the original couplers. A large proportion of such knuckles and locks have varied from the original design to such an extent that it directly affected the operation of the coupler, which not only results in troubles from parting, but also has a direct influence on the breakage of the coupler and knuckle parts. This is aside from the question of inferior metal used in such knuckles and the fact that they are not tested under M. C. B. specifications. Separate knuckles for repairs should be purchased according to M. C. B. specifications, for economy as well as in justice to the owners of the cars who have originally applied couplers in compliance with the interchange rules and standards of the M. C. B. Association.

BROKEN LOCKS, ETC.

A large number of locks, knuckle throwers and other like parts were examined. The data obtained are of no particular value for comparison, but the examination emphasized a number of points to which your committee desires to call attention. A great majority of the lock failures were due to the breakage of the lock chain attaching the lock block to the uncoupling lever chain, which is the weak point of a lock of this type. It is not within the province of your committee to make definite recommendations concerning the form of lock, as most of the coupler patents are based on this feature, but where the flexible link connection is used from the lock block to the uncoupling lever chain it should be strengthened.

CONCLUSIONS.

This investigation has pointed out wherein the different types of couplers and knuckles are failing, and has satisfied your committee that a closer observance of the M. C. B. specifications in purchasing couplers and the insistence of the railroads on having the couplers tested in accordance with the requirements of the Association will overcome much of the trouble from breakage of couplers, knuckles and parts which is now being experienced.

UNCOUPLING ARRANGEMENT.

Defective uncoupling arrangements are an increasing source of trouble on account of the bending of the uncoupling rods, breakage of uncoupling chains and loss of pins from the clevises. The breakage of these chains is very often due to the excessive slack in the draft rigging, and as the length of chain must necessarily be limited to obtain the proper amount of lift for the locking pin it cannot well be lengthened. With the knuckle-throwing couplers the amount of lift of the locking-pin is increased, which feature aggravates this trouble. In view of the foregoing, your committee believes that some better means should be provided for operating the locking device, but is prevented from making any definite recommendations on account of patented devices. In order to provide for increased strength at this point, a recommendation is appended to make the diameter of the eyelet at the top of the locking device for uncoupling rigging, 1 1-16 inches.

The lock-set within the head of the coupler is now standard, so that there is no longer any necessity for the lip on the outside bracket, No. 1, shown in Recommended Practice, Sheet "B." The uncoupling lever is frequently allowed to hang on the lip of this casting while coupling cars, and when this is done it results in a large amount of damage to locking-pins and sometimes causes breakage of knuckles and couplers.

RECOMMENDATIONS.

The recommendations which your committee offers to be submitted to letter ballot, to be adopted either as standard or recommended practice, is as follows:

STANDARDS.

(Under this head where changes in standards also involve changes in specifications, both are included in the same recommendation.)

1. "That the lock lift must be in the central longitudinal vertical plane of the coupler, located between the striking horn and contour lines, and must operate from the top by an upward movement."

Also add this requirement to paragraph No. 4 of "Specifications for M. C. B. Automatic Coupler."

2. "That couplers must be so designed as not to part when the knuckle pin is removed or broken."

Also add to first sentence of paragraph No. 4 of "Specifications for M. C. B. Automatic Couplers,"—"and must be so designed as not to part when the knuckle pin is removed or broken."

3. Change paragraph No. 8 of "Specifications for M. C. B. Automatic Couplers" to read: "8. Every coupler and knuckle made to comply with these specifications must have a slightly raised plate or flat surface cast upon the head in plain view where it will not be subject to wear. After a lot of complete couplers have successfully passed the inspection and tests prescribed below, the letters M. C. B. must be legibly stamped upon the plate on each coupler and knuckle; this mark to be evidence that the complete coupler is an M. C. B. standard."

Add a paragraph No. 7 to "Specifications for Separate Knuckles" to read: "7. Every knuckle made to comply with these specifications must have a slightly raised plate or flat surface cast upon the head in plain view where it will not be subject to wear. After a lot of knuckles have successfully passed the inspection and tests prescribed below, the letters M. C. B. must be legibly stamped upon the plate on each knuckle; this mark to be evidence that the knuckle is an M. C. B. standard." Omit number of first paragraph under "Inspection" which is marked 7.

4. Add at the end of the first paragraph under "Jerk Test" in "Specifications for Separate Knuckles": "If preferred by manufacturers, an old coupler and lock of the same kind, in which the knuckle fits properly, and which may be suitably reinforced in order to endure as many tests as possible, may be used in place of supporting casting for this test."

5. That the "Specifications for M. C. B. Separate Knuckles" with changes as recommended above be adopted as standard.

6. "That a butt 5 x 5½ x 9⅛ inches for friction draft as shown on attached sheet 'O' be adopted as standard."

7. "That the spacing between center sills be 12⅞ inches."

8. "That front and back stops, with rivet holes, 15-16 inch in diameter spaced as shown on Sheet M. C. B. 'B', drawings 'A' and 'B,' be adopted as standard."

9. "That spacing between coupler horn and buffer beam be 1¾ inches for all spring gear and 2¾ inches for all friction gear."

10. "That followers be made of wrought iron or open-hearth steel 1⅝ inches thick for tandem spring gear and 2¼ inches for twin spring and friction gear."

11. "That the total side clearance of the coupler be not less than 2½ inches."

12. Change left-hand part of Sheet M. C. B.-11 so as to conform to sheet "O" submitted.

RECOMMENDED PRACTICE.

1. On Sheet M. C. B. "B," change dimension showing distance between gibs on all three yokes from 7¾ inches to 6¾ inches.

2. Omit uncoupling attachment casting No. 1 from M. C. B. sheet "B" and substitute casting No. 5 for casting No. 1 in diagrams Nos. 1 and 3, and omit under Recommended Practice for "Uncoupling Arrangements for M. C. B. Couplers," second sentence of fifth paragraph beginning "Diagram No. 3 shows."

3. "That the eyelet for the uncoupling attachment in the top of the locking device be 1 1-16 inches in diameter."

4. That "Specifications for Knuckle Pins" be adopted as Recommended Practice.

What Can the Master Car Builders Do to Secure More Rapid Movement of Freight Cars and Prevent Delays Under Repairs and Inspection?*

It is a well-known fact that a freight car, in addition to performing its legitimate work of transporting traffic, is required to withstand a 25-mile per hour impact when loaded and passed through gravity and hump yards; to be kicked, poled, roped and cornered; to be mauled and turned upside-down for dumping; to receive red-hot lading, such as billets, pig iron and slag; to resist the steam, fire and dynamite that is used to loosen frozen loads of coal, sand and ore; to submit to the depreciating action of acids, alkalis, water and weather; to retain any load that can be safely got into or on top of it; to endure loading by crane hoist; to undergo removal of lading by clam shell, scraper or plow; to be able to lose any part of itself that may facilitate loading or unloading, and withal to retain its identity and return to its owners after a year's sojourn in Canada, Mexico and the United States with a clear record against delay, failure, personal injury, loss or damage, and the Interstate Commerce Commission inspection. Assuming, however, that the transportation and traffic departments may have exhausted their means to increase the movement of freight by the greater lading and quicker handling of cars, there is no doubt that the Master Car Builders can render additional assistance. From the past year's experience and considering only equipment now in use, it appears that consideration should be given to the following:

(1.) Regulations to facilitate the handling at interchange points of loaded freight cars that are safe to move.

(a) If the Master Car Builders' rules are to facilitate the disposition of cars in interchange service and to properly place the responsibility for defects which may or may not make them unfit for movement, what objection should there be in stimulating car owners to make substantial repairs to equipment before it leaves the home lines by the inauguration of a rule such as:

"When a loaded car contains specified owner's defects which do not render it unsafe to move but make it liable to develop a delivering company's combination of defects, it must be accepted from owner's line if covered by a liability card authorizing repairs to, or acceptance of car on the owner's line with such a combination of defects as may properly be the result of the specified owner's defects."

Such a rule should not only facilitate the handling of loaded cars and keep them moving as long as in a safe condition, but it would also require the owners to apply the necessary betterments and repairs to equipment that they offer in interchange for the purpose of maintaining it in substantial condition and thereby relieve themselves of extraordinary expense due to cumulative repairs that are now made necessary on account of not taking "the stitch in time" when they have the cars in their possession.

(b) Another matter that should be given consideration is to make loaded and empty cars acceptable at all interchange points on such roads as will insure proper accounting for repair charges. This can be done by agreements between connecting lines providing for the appointment of joint inspectors who will prevent the holding of equipment and transferring of lading on account of too much or unintelligent inspection and on technicalities.

(c) It would also be well to establish the fact that progress is being made in interchangeability and shop practice by specifying that bad order cars shall be no exception to the rules governing serviceable cars except where they are unsafe to load on account of general worn-out condition due to age or decay. The continuance of the *per diem* on foreign cars during the period they are held for owner's material for repairs would certainly result in much less time being taken to make the repairs than what now occurs.

(2) Competent interchange and terminal car inspectors.

Taking into consideration the regular and special rules covering the inspection, condition, repairs, loading, clearances, billing and movement of freight cars, as issued by the Master Car Builders' Association, Interstate Commerce Commission and the railroad transportation and mechanical departments, it is not difficult to understand the urgent necessity for labor capable of performing the interchange and terminal inspection in a way that will accelerate rather than retard movement. Instructions and criticisms have become so frequent and voluminous that we can certainly expect a vigilant car inspector to be able to determine upon one or more details in each car passing his inspection, that will delay its movement. It, therefore, becomes most essential that the chief, foreman, joint, leading, or other similarly classified car inspector whose duty it may be to supervise regular inspectors, shall be a man of such general qualifications that he can be depended upon to direct compliance with the rules in a manner that good judgment may decide to be safe and proper for all concerned, as well as consistent with the least delay to traffic and the greatest economy in maintenance.

(3.) More substantial repairs to cars when on home lines.

In consideration of the fact that the average serviceable freight car may have an earning capacity of from $2.50 to $3 per day, even when standing still for about 21 out of every 24 hours, it is easy to approximate the increased revenue that might be derived if the Master Car Builders could reduce the number of bad-order loaded and empty system and foreign revenue freight cars held over each day for all classes of accident and ordinary repairs (exclusive of defective cars held under load at destination and excepting after Sundays and legal holidays), to a basis of 3 per cent. of the total system and foreign revenue cars on the line.

However, it is an expensive procedure to clear the "cripple" tracks by the making of indifferent repairs, and where desirable system cars reach the shop tracks in an empty condition they should receive such renewals and betterments as will put them in a substantial condition, so that the repetition of the class of repair work that results only in temporary maintenance can be discontinued in order to reduce the successive line failures of equipment and detention to cars and traffic, as well as the continually increasing expenses for non-productive labor and material.

It is, therefore, especially urgent that the Master Car Builders shall promote the best interests of the shippers and dealers, as well as of the railroads they represent, by the inauguration of substantial repair practices that will insure the minimum delay of cars on the shop tracks and line of road chargeable to their general condition.

(4.) Thorough inspection, repairs and adjustment of cars before loading and careful attention to brakes, lubrication and lading after classification at load originating terminals.

Cars set off on the line of road due to bad order condition of couplers, draft attachments, wheels or brakes, heated bearings, shifted lading and other similar causes are usually the outcome of lack of proper originating terminal attention which results in accidents, destroyed lading and cars, reduced train rating, delays to traffic, blocking of passing sidings, engine and train crew overtime and extraordinary expense for sending labor and material out on the line to make repairs. Regardless of whether system, foreign or private line equipment is involved, the Master Car Builders should see that all receive the same attention in this respect, as a foreign or private line car is liable to cause just as much, if not more, line trouble when under load than a home car.

(5.) Cars damaged by accident, but safe to move, should be repaired for return loading instead of being routed home empty.

Where at all practicable to do so, light mileage on account of condition of equipment should be eliminated, and when cars can be made safe to run and lading is available they should be put in condition for return loading.

(6.) The restriction to home lines of cars that are not suitable for interchange service.

At the present day nearly all railroads are offering in interchange some loaded and empty cars that are of such capacity, design or condition as to make them entrely unfit for the service to be performed. This class of equipment, which cannot be depended upon to promptly pass interchange inspection, should be restricted to those owners' lines where it can haul the maximum amount of commercial or company's use lading with the least liability for delays, transfer or repairs.

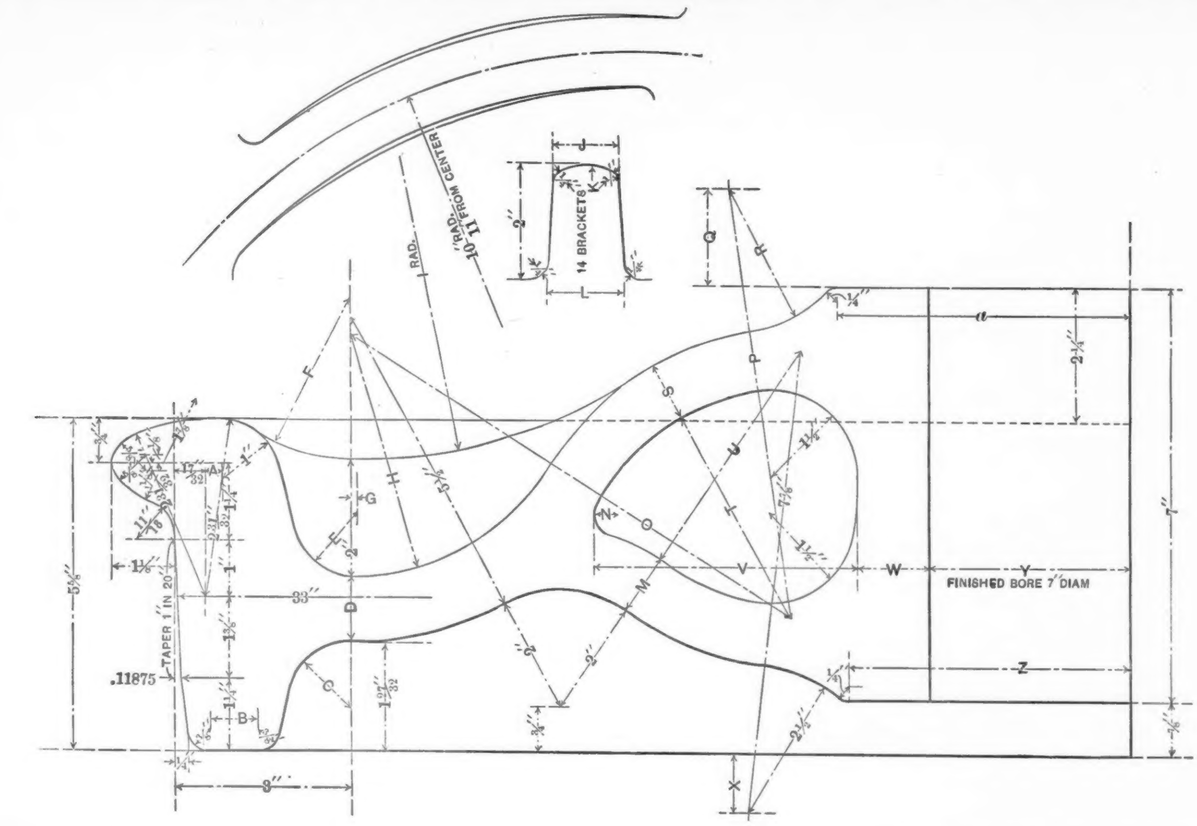
(7.) Cars unsuitable for either company's or commercial use to be dismantled.

When a freight car of undesirable class and capacity has outlived its usefulness from the standpoint of commercial utility and reaches the home shop tracks in such bad order condition due to age, delay, corrosion or accident that the expenditure necessary to put it in serviceable condition is not justified, it should be dismantled. Connecting railroads handling either interstate or intrastate traffic should be assured of the absolute elimination of this class of equipment from further service on their lines.

In conclusion it may be stated that the great demand at the present time for increased facilities for moving industrial and agricultural products to market makes this topic of universal interest. The public insists upon railroads providing safe, fast and frequent freight service, such as can only be obtained from equipment receiving the most substantial attention in the way of repairs and inspection. The freight yard and train operations have become most severe on rolling stock. Relieving switchmen and brakemen of the necessity of going between cars to make couplings is no doubt responsible for much rough usage and failure of equipment. The gravity and hump yards and longer trains have also contributed generously to the cripple tracks. Furthermore, the conditions imposed by the placing of cars of light capacity and design between those of heavier types at the head end of trains, in combination with double, triple and overloaded equipment and the frequently reported "bad triple" and "burst hose" must also be met.

In view of the large number of cars in service that were designed and constructed long before the results from the changed conditions could be realized, the Master Car Builders deserve much credit for the progress that they have made in promulgating general practices and facilitating transportation. However,

* Paper presented by Mr. J. E. Muhlfeld as a topical discussion on this subject.



the urgency for the handling of freight now awaiting movement gives them an opportunity to further demonstrate their resourcefulness and broad, progressive methods by stimulating such action as will eliminate whatever sluggishness may still exist in the repair and inspection practices.

Cast-Iron Wheels.

Committee—Wm. Garstang (Chairman), A. S. Vogt, H. J. Small, W. E. Fowler, R. L. Ettinger, R. F. McKenna, J. E. Muhlfeld.

The committee reported the following outline of work accomplished during the past year, working jointly with the American Railway Association committee on standard wheel and rail sections, Mr. G. L. Peck, chairman, the personnel of the latter committee remaining the same as reported in the proceedings of this Association for 1906.

Two joint meetings of the committee were also held with a committee representing the car wheel makers of the United States, and both were of prime importance and assistance in getting the endorsement of the wheel makers, and in reviewing the commercial factors which are at present affecting the subject from the wheel makers' standpoint. The committee having received the support of Master Car Builders and American Railway Associations on its recommendations covering the *increased thickness of flange and coning of the tread* has confined its work during the past year to the revision of the drawings and specifications, and the design of a complete set of gauges of various descriptions required for cast-iron wheels, to replace those now shown in the standards and recommended practice of this Association, to suit the requirements of the new flange and tread adopted in 1906, as well as the standard flange and tread adopted by this Association and in general use prior to that date.

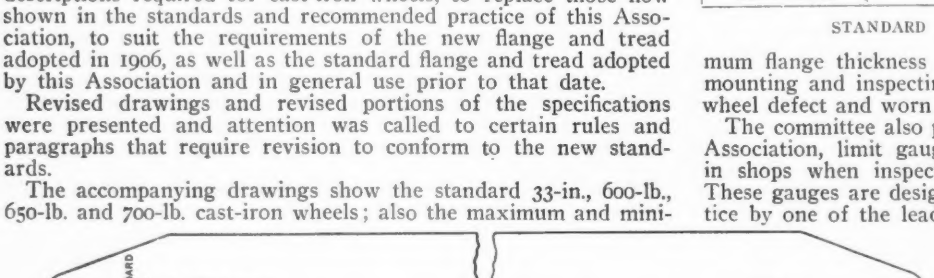
Revised drawings and revised portions of the specifications were presented and attention was called to certain rules and paragraphs that require revision to conform to the new standards.

The accompanying drawings show the standard 33-in., 600-lb., 650-lb. and 700-lb. cast-iron wheels; also the maximum and minimum flange thickness gauges, the standard reference gauge for mounting and inspecting wheels, the wheel check gauge and the wheel defect and worn coupler limit gauge.

WT. WHEEL	600 lb.	650 lb.	700 lb.
A	—	19/64	19/64
B	5/8	3/4	13/16
C	1 5/16	1 3/16	1 1/8
D	27/32	1	1 7/32
E	1 5/16	1 1/8	1 1/8
F	2 23/32	2 7/16	2 3/4
G	—	3/32	3/32
H	4 5/16	4 5/32	4 7/16
I	9 1/2	9 1/2	9 1/4
J	7/8	1 1/8	1 1/8
K	3/4	1 1/8	1 1/8
L	1 1/8	1 5/16	1 3/8
M	13/16	15/16	1 1/16
N	13/32	5/8	3/8
O	8 15/16	8 31/32	8 31/32
P	7 1/8	7 3/8	7 11/32
Q	1 1/2	1 21/32	1 21/32
R	2 1/2	2 9/16	2 7/16
S	3/4	7/8	1
T	3 7/8	3 15/16	3 29/32
U	4 9/16	4 7/16	4 5/16
V	5 7/16	4 15/16	4 9/16
W	1	1 1/8	1 1/4
X	1 1/16	1 1/32	1
Y	2 7/8	3 1/4	3 1/2
Z	4 3/16	4 11/16	4 7/8
a	4 5/16	4 13/16	5 1/16
FIN. BORE	5 3/4	6 1/2	7

STANDARD 33-IN. CAST-IRON CAR WHEEL.

The committee also presented for approval and adoption by the Association, limit gauges, as shown in the illustration, for use in shops when inspecting second-hand wheels for remounting. These gauges are designed along lines determined in actual practice by one of the leading railroads, and the angle gauging face having a taper two and one-quarter in twelve inches is the result of several years' experience, and has been found to meet requirements in a satisfactory manner.



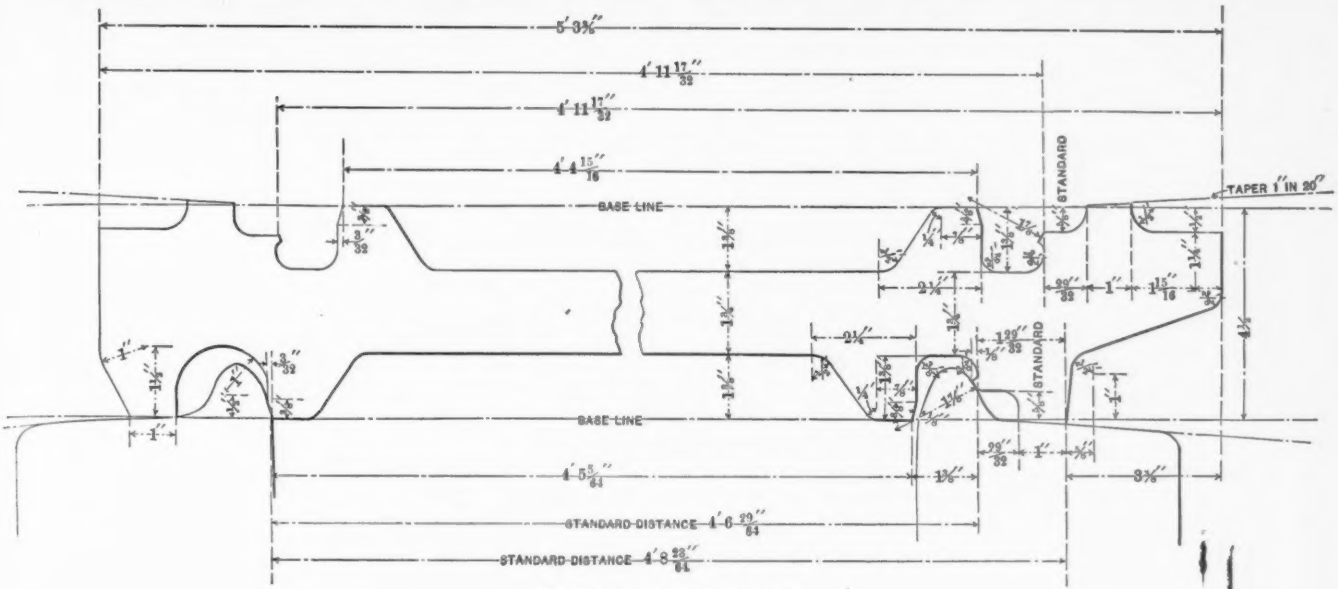
WHEEL CHECK GAUGE.

Subjects.

Committee—W. E. Symons, William Forsyth, H. LaRue.

SUBJECTS FOR COMMITTEE INVESTIGATION DURING THE YEAR 1907-1908.

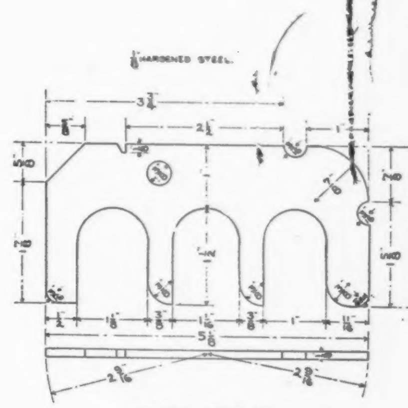
The lateral bracing of steel freight cars; also the proper design for



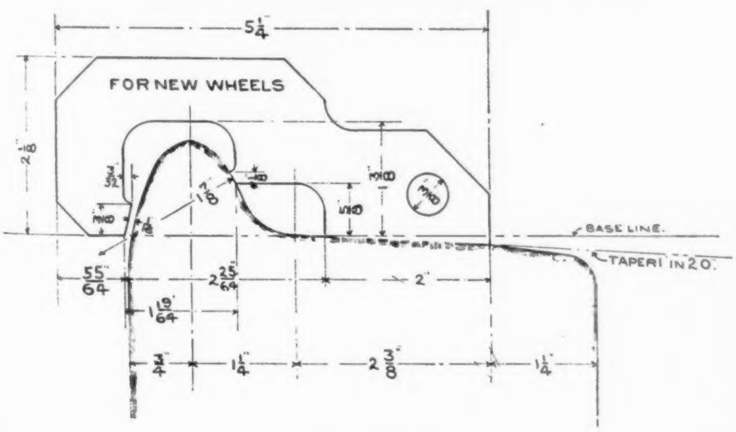
STANDARD REFERENCE GAUGE.

the superstructure of steel box cars. The majority of wooden cars have no diagonal bracing in the underframing, depending on bolted joints and connections to keep the bodies square. In the case of a severe shock a wooden car will spring and give, but return to its former lines, while cars of steel or composite construction, on account of inability to spring after a severe shock, will remain sprung and bent out of line. The same committee to investigate the design of the upper framing of box cars. C. A. Seley, W. F. Kiesel, Jr., W. J. McKeen, Jr., committee.

Side bearings and center plates for freight cars and locomotive tenders. Committee to recommend a standard spread, height and clearance for side bearings, review and give synopsis of reports on side bearings and center plates made to the Association in the past, since and including 1900; to present plans for the most improved anti-friction side bearings and center plates and recommend the proper proportions for ball and roller bearings. The investigation and report to embrace the relations which center plates and side bearings may bear to derailments. Alfred



WHEEL DEFECT AND WORN COUPLER LIMIT GAUGE.



MAXIMUM FLANGE THICKNESS GAUGE.

F I G. 7.

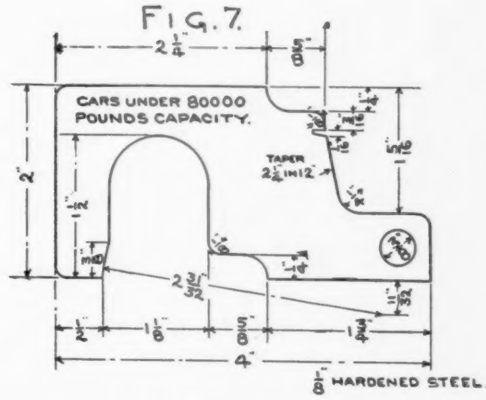
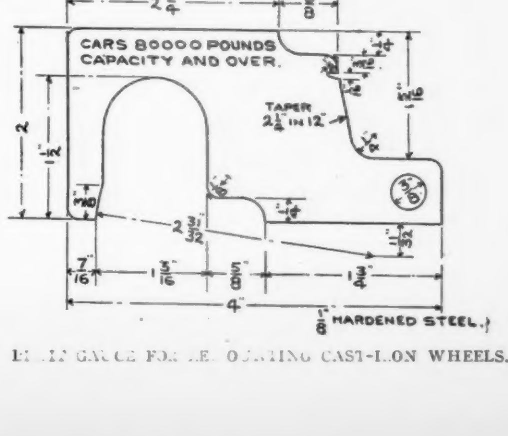
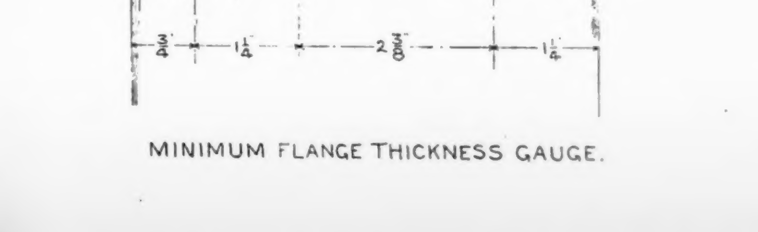


FIG. 8.





MINIMUM FLANGE THICKNESS GAUGE.

[illegible] GAUGE FOR [illegible] CAST-IRON WHEELS.

Lovell, H. J. Small, O. M. Stimson, C. A. Schroyer, A. W. Gibbs, committee.

Friction Draft Gears:

First: To recommend a standard maximum capacity.

Second: The most desirable resistance during each ⅛-inch compression.

Third: A standard maximum weight for the friction draft gear proper.

Fourth: The proper design for the attachment of friction draft gear.

Fifth: The value of friction draft gear in reducing damage to cars and their contents. J. E. Muhlfeld, F. M. Whyte, W. H. V. Rosing, R. D. Smith, committee.

Steel Passenger Cars. To recommend a standard sectional area for the center sills and cover plates, the relative merits of steel passenger cars with an upper deck and those with a semi-elliptical section without upper deck; the best construction for flooring and relative merits of various materials for inside finish for fireproof construction. W. A. Nettleton, E. A. Benson, Representative American Car & Foundry Company, T. Rumney, R. L. Ettinger, committee.

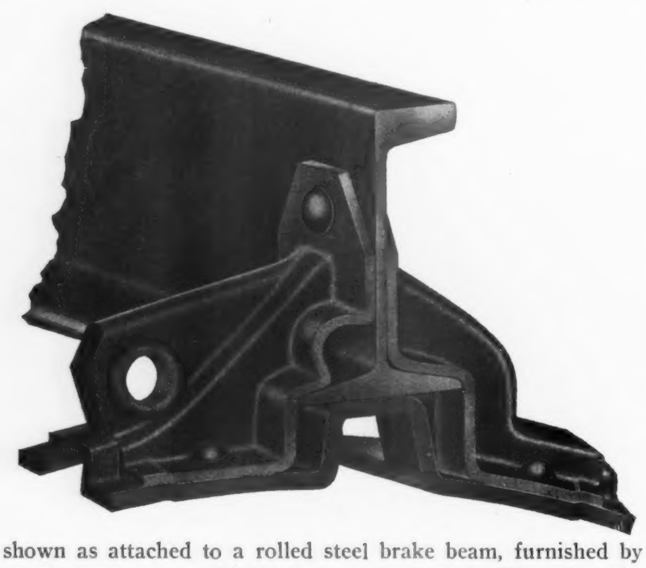
The ventilation and heating of coaches and sleeping cars. To investigate methods for the regulation of the temperature and the supply of fresh air to passenger cars with special attention to comfort in sleeping cars; to recommend plans which provide for the regulation of heat and air supply by the occupant of each berth. R. P. C. Sanderson, Joseph A. Buker, William O'Herin, W. E. Fowler, F. H. Clark, committee.

Protective coatings for steel cars; the method of application and results of experiments made therefor. C. A. Fuller, T. H. Russum, F. H. Clark, S. T. Parks, committee.

A FORGED STEEL BRAKE HEAD.

A new brake head of forged steel, which conforms in every respect to M. C. B. standards, has recently been designed and is being manufactured by the Buffalo Brake Beam Company. This head has been designed to fill the difficult requirements of modern heavy equipment and high speed, and can be considered as a distinct step in the direction of increased safety and economy.

The illustration shows the construction very clearly. The head



is shown as attached to a rolled steel brake beam, furnished by the same company, to which it is securely riveted. Riveted to the head proper is a removable face plate which can be renewed at small cost in case it should become worn by contact with the wheel through the breaking or wearing of a shoe, thus eliminating the usual necessity of scrapping the whole head. One feature tending to increased safety, which is given by a head of this design, is the fact that there are no key lugs such as are usually found on malleable iron heads, which have been known to break and permit the shoe to drop to the track, with very serious consequences. In this shoe the key has also been given a much greater bearing surface than is usually provided.

Power of Hand Brakes.—Hand brakes which will work in harmony with the air brakes should be used on all equipment, and the power exerted by the hand brake be not less than 40 per cent. of the light weight of car, nor more than that of the air brake, on passenger equipment. It is believed that the average hand brake power now available on such cars will approximate 25 per cent.—*Report of Committee, Air Brake Association.*

A REMINISCENCE OF THE CONVENTIONS.

One of the exhibits at the M. M. and M. C. B. conventions at Atlantic City which attracted much attention was that of the American Blower Company, who introduced a novelty decidedly mystifying to the wise ones. One of their high-pressure blowers was put in operation, and, emitting from the discharge a blast of air at high velocity, which held a light rubber ball about 12 in.

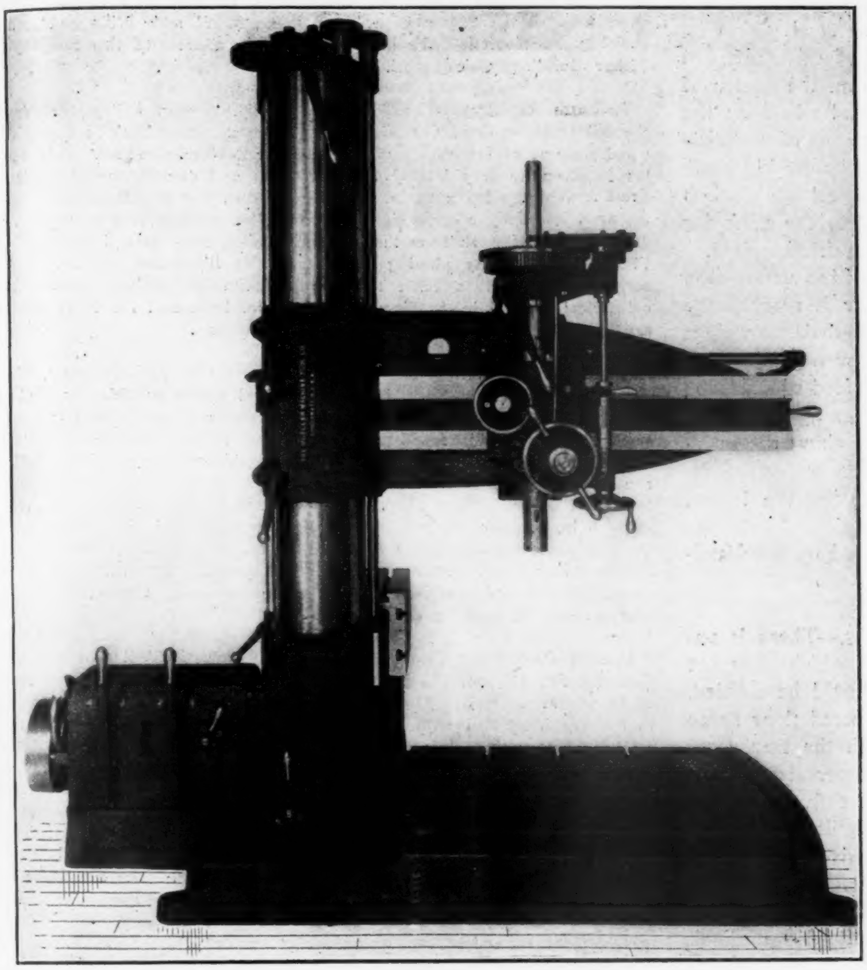
in diameter suspended about 4 ft. from the outlet. Just why the ball remained at that point instead of flying off into the ocean was what puzzled the attending engineer delegates. The invariable question propounded to the overworked representatives of the company was: "How do you do it?" Alternated with: "Where is the string?" "Some electrical control?" etc. Anyone who wants the real explanation of how it was done can obtain it by writing the American Blower Company, Detroit, Mich.

Car Efficiency.—The report of the committee of the American Railway Association on Car Efficiency shows the following conditions to have existed in this country and Canada for six different periods during this year.

Date.	Roads.	Surplus.	Shortage.
Jan. 2	74	24,517 cars	83,110 cars
Feb. 6	68	12,563 "	103,095 "
April 10	70	17,612 "	70,362 "
May 15	86	19,622 "	47,445 "
May 29	84	23,809 "	38,300 "
June 12	85	31,217 "	33,088 "

The Lighting of the Planing Mill is best accomplished by arc lamps, but these must be well enclosed to prevent the mingling of sparks and dust. It seems as if the mercury vapor lamp would be an ideal one for a mill, as there is no chance of fire from incandescent particles of carbon or by any incombustible material outside of the glass tube. If incandescent lamps are used they should always be covered with cages, as they are very liable to be struck by timbers which are being handled and turned.—*Mr. G. R. Henderson at the New England Railroad Club.*

Chemical Fire Engines for Coal Mines.—For fighting fire in its anthracite coal mines a new form of chemical fire engine is now being used by the Delaware, Lackawanna & Western Railroad. The engine is mounted on a truck suitable for the tracks throughout the mines and is hauled by means of an electric mine locomotive. Great difficulty has been experienced in putting out fires in mines by means of water on account of the formation of a gas so suffocating as to drive the fire fighters away. A chemical engine, however, works much more satisfactorily as the gases evolved are very heavy and cling to the floor and assist in smothering the fire. The fumes are not as annoying to the firemen, who can stay close enough to do effective work.



NEW FOUR-FOOT RADIAL DRILL.

A NEW RADIAL DRILL.

A new radial drill designed to meet the modern conditions of high-speed steel and maximum output is shown in the accompanying illustrations. This machine is provided with twenty-four changes of speed to the spindle and eight changes of automatic feed for each spindle speed, any of which can be instantly changed while the driving belt is in motion without noise or shock. These changes of both speed and feed are conveniently obtained and are between sufficiently wide limits to permit the developing of the full capacity of the machine under any and all circumstances.

Speed Box.—The speed box is located on the base of the machine, close to the column, and is of a very compact and convenient design. The arrangement of the gears and clutches is shown in the accompanying line drawing. It will be seen that the driving shaft carries two double friction clutches, operated from the two long levers shown in front of the speed box in the photograph, by which four changes of speed of the intermediate shaft can be obtained. The speed of the upper shaft, which carries splined to it a set of three gears which mesh with the three gears on the intermediate shaft, is controlled by the small lever shown at the right of the speed box. This has three positions, bringing either gear E, D or F into mesh with the similarly marked gears on the intermediate shaft. Thus there are twelve changes of speed obtainable by the gear box, which is increased to twenty-four by means of a back gear located on top of the column and controlled by a lever at the base. Another connection in the gear box is one which meshes gear D on the upper shaft with gear G on the driving shaft, thus causing the direction of rotation of the upper shaft to be reversed and to run at an increased speed. This connection is used for operating the elevating screw when the arm is being lowered. The lever at the base of the column controls the connection of the elevating screw.

The Column.—The column is stationary, constructed of one piece and of heavy section throughout. It is bolted to the base and there are four webs inside extending its entire length, which add materially to the strength of the machine and prevent any springing of the column when the arm and spindle are at their maximum distances.

Arm.—The arm is made in pipe section, its upper brace being as close to the head as possible while the lower brace is at the outer edge. This arrangement tends to stiffen the arm for resisting upward torsional pressure from the spindle when drilling. The arm is carried from a top cap on the column, which rests on roller bearings and permits an adjustment covering the full circle about the column. Fixed binder levers permit the arm to be secured in any desired position. The elevating screw is provided with ball thrust bearings and the lowering speed of the arm is almost three times the elevating speed.

The Spindle.—The spindle is made of crucible steel, is ground and counterbalanced and has a quick advance and return. Provision has been made for taking up all wear in the bearings. The tapping mechanism is all controlled by means of a hand lever, shown in front of the head, which operates two self-adjusting, noiseless friction clutches on the back of the head. These clutches stop, start or reverse the spindle as desired. The design is such that it is impossible to accidentally engage both lever or automatic feed when tapping, thus avoiding the breaking of taps. An adjustable gauge nut causes the spindle to slip when the tap reaches the bottom of a hole.

The Automatic Feed.—The automatic feeding arrangement

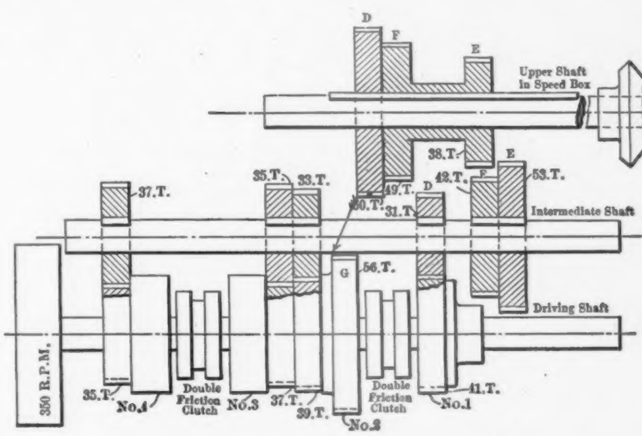
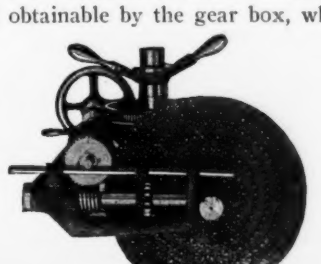


DIAGRAM OF GEARS IN SPEED BOX.

provides a positive feed for the spindle when high speed drills and reamers are in use and at the same time permits a friction feed being used when desirable, the change being made from one to the other by simply turning a nut. The small illustration, which is a view taken from the top of the spindle, shows the



AUTOMATIC FEED MECHANISM.

round plate having eight circles of steel pins, which is located above the spindle gear. These pins engage the steel pinion on the horizontal worm shaft and thus the speed of this shaft can be varied by running the pinion in and out from the center of the plate. A knob located below the lower hand wheel on the head controls the movement of this pinion by means of a sliding rack and gear. These eight changes of feed can be quickly made while the drill is at work. The upper worm wheel has its hub split and by means of a ring nut can be locked to the shaft for a positive feed and can be slightly released for a friction feed.

The automatic trip arrangement is provided with a safety stop which prevents the feeding of the spindle after it reaches the limit of its travel. A graduated bar on the counterbalance weight is set at zero when the drill enters and has several adjustable dogs to trip the feed as often as desired. The feed can also be tripped by a lever on the vertical feed rod.

The letters and numbers cast near the levers show the operator in which direction to move them to obtain the proper speeds. The speeds, together with instructions for operating the levers, are given on the plate attached to the machine.

This machine was designed and is manufactured by the Mueller Machine Tool Company, Cincinnati, O.

Longitudinal vs. Transverse Erecting Shops.—There is another feature in favor of the longitudinal shop which does not always receive the consideration to which it should be entitled, and that is that the cost per square foot of covered floor space is generally less with the longitudinal than with the transverse shop; as an example, we have an average cost per square foot of four longitudinal shops built within the last five years of $1.77, and an average of three transverse shops built in the same period of $2.78 per square foot; and while this difference is greater than would probably generally obtain, yet structural steel manufacturers claim that the transverse shop would cost at least twenty-five cents per square foot more than the longitudinal. As stated above, however, both styles of shop are in general use and both have their good points and their weak points, and the problem should be studied in connection with the environments and climatic conditions; and if the superintendent of the shop feels that he could obtain better results from one type than from the other, we believe that the shape of shop is so secondary to the question of organization that it should be held subordinate to the latter in every case.—*Mr. G. R. Henderson at the New England Railroad Club.*

CATALOGS.

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS JOURNAL.

Finishing Gas Engine Parts.—The Gisholt Machine Company, Madison, Wis., is issuing a leaf to be bound in its loose leaf binder, giving a detailed description, with line drawing, of the most successful method of finishing gas engine pistons and piston rings.

Electrical Apparatus.—The Fort Wayne Electric Works, Fort Wayne, Ind., is issuing several bulletins, among which might be mentioned bulletin No. 1,095 on the subject of enclosed alternating current multiple arc lamps. No. 1,094 on belted direct current generators, and No. 1,096 on type A transformers. Each bulletin is thoroughly illustrated and the descriptive matter is clearly and concisely written.

General Electric Company.—This company is issuing a number of bulletins descriptive of its products, among which are bulletin No. 4,509 on the subject of electric train lighting sets. These sets consist of direct connected turbines and generators suitable for application either on the locomotive itself or in the baggage car. They are thoroughly illustrated and described in this bulletin. Bulletin No. 4,504 is descriptive of tungsten lamps for street lighting. No. 4,516 is on the subject of MR circuit breakers for electric cars. No. 4.514 illustrates and describes the Thompson inclined coil portable indicating instruments. The voltmeters and wattmeters shown in this bulletin are constructed on the dynamometer principle and the ammeters on the mechanical vane principle.

New Rock Drill Catalog.—The Chicago Pneumatic Tool Company is issuing Catalog No. 22 illustrating and describing the "Chicago Giant" rock drills and kindred appliances. The book is printed in colors on high grade paper and contains 96 pages of matter. The text is well written and is embellished with half-tone engravings illustrating the rock drills and detailed parts, as well as several pages devoted to rock drill steels and a description of the method of lubrication used in these drills. Several pages are devoted to the Franklin air compressors, followed by illustrations and description of the "Baby Giant" and "One Man" rock drills and scenes showing the different drills in operation. The address of this company is Fisher Building, Chicago, Ill.

Progress Reporter.—The July issue of the "Progress Reporter" from the Niles-Bement-Pond Company, 111 Broadway, New York, contains the usual amount of interesting matter and excellent illustrations. This number is given up very largely to illustrations and descriptions of the new Pratt & Whitney 2½ x 26 in. open turret lathe, which includes many new features, especially a cross sliding turret. The machine is adaptable for a great variety of work from the bar and also on forgings and castings. A 10 ft. double rotary planing machine is also illustrated and briefly described, as well as a Pratt & Whitney automatic grinding machine for cylindrical work 5 in. in diameter and 48 in. long, and the Niles Gantry crane recently built for the Illinois Steel Company.

Metal Cut-Off Saw.—The Quincy Manchester Sargent Company, West Street Building, New York, is issuing several sheets suitable for binding in its loose leaf catalog binder, which illustrate and describe a new cut-off saw titled 1M. This saw has been designed to meet the demand for a somewhat smaller saw than the standard of this company and one which can be placed upon the market at a somewhat lower price, so as to be within the reach of the smaller shop. It has a capacity for rounds and squares up to 6 in. and for 10- in I beams. The saw blade is 18 in. diameter and the saw blade carriage has a travel of 10 in. This machine embodies all of the strength and wearing qualities of the regular construction and the sheets being issued contain four illustrations showing different views and arrangements of work on the machine.

Dayton Pneumatic Tools.—The Dayton Pneumatic Tool Company, 435 East 1st St., Dayton, O., is issuing a most attractive catalog descriptive of its products. It is a 47-page booklet printed on fine surface paper and thoroughly illustrated with half-tone and line drawing illustrations. The catalog opens with a description of several different designs of pneumatic hammers, each being illustrated and briefly described. Sectional views of the different hammers showing the operating parts are also included. Following this is found a section on pneumatic sand rammers, after which is a section on pneumatic drills. These are built in many sizes and designs, among which might be mentioned the close quarter drill, made in three sizes, and capable of working in very close quarters. The remainder of the catalog is given up to descriptions of other pneumatic appliances such as stay-bolt clippers, pneumatic cylinder hoists, rivet forges and Climax air compressors, which are shown both steam and belt driven, single expansion and compound, in many capacities. This company also furnishes some electric tools, illustrating a portable electric corner drill, a breast drill and a portable hand drill.

NOTES

Magnus Metal Co.—The following appointments have been made to take effect July 1, 1907: D. W. Ross, managing director; W. H. Croft, manager sales department, and W. S. Bostwick, general manager.

The Crocker-Wheeler Company.—In order to handle the largely increased amount of business in electric generators and motors in Southern Ohio, the Cleveland office of the above company has found it advisable to open a sub-office in the Columbus Savings and Trust Company Building, Columbus, O. This office will be in charge of Mr. Charles W. Cross, formerly of the Cleveland office.

A New Engineering Society.—A new society has been organized in Philadelphia called the Engineers' and Constructors' Club. Membership in this is limited to the engineers composing the organization of Dodge & Day. Its object is to discuss subjects relating to engineering and construction and to give all members the benefit of the experiences gained by each in his particular line. The proceedings of the club, giving the papers presented and the discussions, will be published. The officers of the club are H. T. Moore, president; George Walters, secretary. Managers, F. C. Andrews, H. T. Sanville, John E. Zimmerman and C. N. Lauer.

Westinghouse Electric Works.—During the month of May the Westinghouse Electric Company at East Pittsburg shipped 750 carloads of electrical machinery, an average of 30 carloads a day, aggregating 10,000 tons and representing in value about four million dollars. This exceeds, by 110 cars, any shipping record for one month that has ever been made at these works. The Westinghouse Machine Company also reached a high-water mark in May, having sent out from the works 90 engines, aggregating 50,000 h. p. This included gas engines from 10 to 1,000 h. p. and steam turbines from 1,000 to 10,000 h. p.

Electrical Show.—The New York annual electrical show will be held in the Madison Square Garden, September 30 to October 9 inclusive. At this show will be found exhibits of the latest equipment in electrical apparatus, as well as examples of standard practice of all of the well known electrical companies. It offers an exceptional opportunity for a person to cover the whole electrical field and familiarize himself with all the latest products by a very small expenditure of time. It is announced to prospective exhibitors that the price for space is very reasonable and that full particulars will be furnished by Mr. Geo. F. Parker, president, 116 Nassau St., New York.